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HEALTH AND SAFETY PLAN FOR REMEDIATION OF SOLID WASTE MANAGEMENT UNITS
19, 20, 53 NAS FORT WORTH TX
2/4/1993
ARMY CORP OF ENGINEERS



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**NAVAL AIR STATION
FORT WORTH JRB
CARSWELL FIELD
TEXAS**

**ADMINISTRATIVE RECORD
COVER SHEET**

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HEALTH AND SAFETY PLAN
FOR
REMEDICATION OF SOLID WASTE MANAGEMENT UNITS (SWMU)
SWMU 19, SWMU 20, AND SWMU 53
CARSWELL AIR FORCE BASE
FORT WORTH, TEXAS

212002

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FOR
REMEDICATION OF SOLID WASTE MANAGEMENT UNITS (SWMU)
SWMU 19, SWMU 20, AND SWMU 53
CARSWELL AIR FORCE BASE
FORT WORTH, TEXAS

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GLOSSARY OF TERMS, ACRONYMS, AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
AFB	Air Force Base
AL	Action Level
ANSI	American National Standards Institute
analyzer	refers to the field instrument described in Section 7.1
atm	atmosphere
BTEX	Benzene, Toluene, Ethyl Benzene, and Xylene
°C	centigrade
Carcinogen	A substance that can cause cancer
cc	cubic centimeter
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
CIH	Certified Industrial Hygienist
CNS	Central Nervous System
COE	Corps of Engineers
CPR	Cardiopulmonary Resuscitation
CRZ	Contamination Reduction Zone
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
EPA	Environmental Protection Agency
eV	Electron volts
EPA	U.S. Environmental Protection Agency

GLOSSARY OF TERMS, ACRONYMS, AND ABBREVIATIONS (Cont')

EZ	Exclusion Zone
°F	fahrenheit
FID	Flame Ionization Detector
GV	Gasoline Vapors
HC	Hydrocarbons
HEPA	High Efficiency Particulate Air
HR	Heart Rate
IHT	Industrial Hygiene Technician
kg	kilogram
LEL	Lower Explosive Limit
Lpm	liter per minute
MSDS	Material Safety Data Sheet
m	meter
mg	milligram
mg/M ³	milligram per cubic meter
ml	milliliter
mm	millimeter
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
OBZ	Operator's Breathing Zone
OEL	Occupational Exposure Limit

GLOSSARY OF TERMS, ACRONYMS, AND ABBREVIATIONS (Cont')

OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer (Foxboro-Century Model 108)
PEL	Permissible Exposure Limit
PM	Project Manager
PPE	Personal Protective Equipment
ppb	parts per billion
ppm	parts per million
REL	Recommended Exposure Limit
SSHP	Site Safety and Health Plan
SOP	Standard Operating Procedures
SSR	Subcontractor's Safety Representative
STEL	Short Term Exposure Limit
SZ	Support Zone
THC	Total Hydrocarbons
TLV	Threshold Limit Value
TLZ	Truck Loading Zone
TPH	Total Petroleum Hydrocarbons
UEL	Upper Explosive Limit
USACE	United States Army Corps of Engineers
VOC	Volatile Organic Compound

HEALTH AND SAFETY PLAN
FOR
REMEDATION OF SOLID WASTE MANAGEMENT UNITS (SWMU)
SWMU 19, SWMU 20, AND SWMU 53
CARSWELL AIR FORCE BASE
FORT WORTH, TEXAS

1.0 INTRODUCTION AND APPLICABILITY

The purpose of this plan is to assign responsibilities, establish the overall site health and safety program standards and mandatory safety procedures, and provide for contingencies that may arise during remedial activities at the Carswell Air Force Base Site (Site). This plan complies with, but does not replace, Federal Health and Safety Regulations as set forth in 29 CFR 1910 and 1926. This program is to be used by Site personnel as a supplement to such rules, regulations, and guidance. The provisions of this plan are mandatory for all project personnel engaged in Site remediation activities that may involve health and safety hazards.

One of the first tasks of the field program is to collect additional soil samples for laboratory analysis. If laboratory analysis indicates results that differ significantly from the previous analytical data, then this Site Safety and Health Plan (SSHP) will be modified to reflect these changes. All proposed changes to this SSHP should be reviewed with the Contractor's Certified Industrial Hygienist (CIH), with concurrence of the Contracting Officer, prior to their implementation. If this is not feasible, the Project Manager may modify the plan and record all changes in the field log book; under no circumstances will modifications to this plan be permitted that conflict with Federal, state, or local health and safety regulations.

Four asbestos-containing cement pipes will be removed during remedial activities at Carswell AFB. All health and safety activities related to the removal and disposal of the asbestos-containing pipes are addressed in the Asbestos Removal and Disposal Plan provided by Total Abatement Systems Company (TASCO).

A copy of this Health and Safety Program shall be provided to each site subcontractor in order to fulfill the obligations under 29 CFR 1910.120(b)(1) to inform subcontractors of site hazards.

2.0 FACILITY BACKGROUND/WORK PLAN

2.1 SITE HISTORY

Carswell AFB is located in the Northwestern portion of Fort Worth, Texas. Previous activities at the site have generated soil contamination in three Solid Waste Management Units (SWMU) 19, 20 and 53.

SWMU 19 and 20 are known as the Fire Training Area. This area consists of two low earthen berms, with the outside berm being approximately 260 feet in diameter and the inner berm being approximately 120 feet in diameter. Approximately 25 to 30 dumpsters and one 9,000-gallon Aboveground Storage Tank (AST) are located within this area. When the fire training area was in use, fuel was pumped from the above ground storage tank to the dumpsters; the dumpsters were then set on fire to simulate a burning aircraft.

Soil sampling activities were previously conducted in this area. Analytical results of the samples collected indicated concentrations of less than 3500 mg/kg of Total Petroleum Hydrocarbons (TPH) and less than 50 mg/kg of benzene, toluene, and xylene.

SWMU 53 is currently known as the Flightline Ditch. The Flightline Ditch is a 600-foot long earthen section of a storm drainage ditch which is located adjacent to the Carswell AFB Flightline. Thorough sampling efforts in this area have found that minor contamination has occurred in ditch soils as a result of past drainage. The ditch also currently contains four asbestos-containing telephone conduits.

Soil samples collected from this area indicated levels of between 99 and 3500 mg/kg of Total Petroleum Hydrocarbons (TPH).

2.2 SCOPE OF WORK

The objective of this project is to remove contaminated soil and materials from the three Solid Waste Management Units (SWMU) at Carswell AFB. Once the contaminated soil has been removed from the areas of concern, it will be transported to a biotreatment cell to undergo bioremediation activities.

2.2.1 Remedial Activities in the Fire Training Area (SWMU 19 and 20)

Remedial activities for SWMU 19 and 20 will consist of the following:

- Removing sediment and liquid residue from the bottom of 25 to 30 dumpsters using a vacuum truck;
- Testing the contents of the dumpsters prior to disposal;
- Loading the dumpsters onto a truck and hauling them to a certified disposal facility;
- Testing the contents of the 9,000-gallon Aboveground Storage Tank (AST);
- Removing approximately 4,500 gallons of Jet Fuel #4 (JP-4) from the AST and hauling this product to a certified facility for disposal; and
- Purging, removing and disposing of the AST and associated piping.

After the dumpsters, aboveground storage tank, and associated piping have been removed from the facility, contaminated soils from SWMU 19 and 20 will be excavated to an approximate depth of three feet below ground surface (bgs). Excavated contaminated soil will then be loaded into dump trucks and taken to the biotreatment cell where it will undergo bioremediation. Confirmatory soil samples will be collected from SWMU 19 and 20 after the contaminated soil has been removed.

If the confirmatory soil samples indicate that contamination is still present in SWMU 19 and 20, then additional soil will be excavated until confirmatory samples indicate that levels of TPH are below current cleanup standards. After excavation activities are complete, clay and top soil will be imported, placed, and compacted to bring the excavated areas up to grade.

2.2.2 Remedial Activities for the Flightline Ditch (SWMU 53)

Remediation activities for SWMU 53 will consist of the following activities:

- A trackhoe with a demolition hammer will be used to break up concrete rubble and headwalls located in SWMU 53;
- Four asbestos cement pipes will be removed by Total Abatement Systems Company (TASCO), a Certified Asbestos Abatement Contractor;
- Soil and rubble samples will be collected for chemical analysis to further characterize the contaminants in the soil of SWMU 53;
- Contaminated soil in the Flightline Ditch will be excavated and confirmation soil samples will be collected. Soil will be excavated until confirmation samples indicate levels of contaminants are below current cleanup standards;
- Excavated contaminated soil will then be loaded into 14 cubic yard dump trucks and taken to the biotreatment cell where it will undergo bioremediation;
- Once the soil in the Flightline Ditch has been determined "clean" through sampling techniques, the channel will be graded, a collector pipe will be installed, a headwall will be constructed, and concrete paving that follows the collector line will be installed; and
- The area will be seeded as required.

2.2.3 Bioremediation Activities

A bioremediation treatment cell will be constructed at the Carswell AFB site for placement of TPH contaminated soils. This biotreatment cell will be constructed of a 20-mil polyvinyl chloride (PVC) liner surrounded by berms constructed of clay. A sump will be installed to collect runoff.

The bioremediation test plot will be watered, tilled, fertilized, and sampled on a weekly basis for approximately 16 weeks. After the cell is sampled clean, the soil will be loaded into trucks and hauled to a predetermined location.

3.0 SAFETY PROGRAM ADMINISTRATION

The provisions of this health and safety program along with the applicable regulations issued by governmental entities will be strictly adhered to by Site personnel and visitors. Each contractor will be held accountable for the safe and healthful performance of work by each of their employees, subcontractors, or support personnel who may enter the site.

3.1 OCCUPATIONAL HEALTH PHYSICIAN

An American Board of Preventative Medicine-Certified Occupational Health Physician will provide medical examinations and surveillance for all project personnel. The Occupational Health Physician is responsible for implementing the following medical surveillance activities:

- Overseeing the medical surveillance program;
- Reviewing the physical exams administered by local medical providers;
- Reviewing all pertinent medical records and exams;
- Providing a written physician's opinion for each employee concerning the ability to perform work at hazardous waste sites, the ability to wear a negative-pressure respirator, and the ability to wear protective clothing that may cause heat stress; and
- Providing a statement after examination that the employee has been informed of the site hazards and advised of the results of the physical examination.
- Providing a final written opinion for the Phase-Out Report.

As required under Section 1501, Subsection 4.5.1 of the Carswell AFB Specifications for Remediation of Solid Waste Management Units (SWMU) SWMU 19, SWMU 20, and SWMU 53, the Occupational Health Physician has been informed of the site conditions and is aware of the potential health hazards associated with site work at Carswell AFB.

A copy of the Curriculum Vitae for the Certified Occupational Health Physician, Gary R. Krieger, MD, MPH, DABT is located in Attachment N.

3.2 CERTIFIED INDUSTRIAL HYGIENIST

An American Board of Industrial Hygiene-Certified Industrial Hygienist will administer this Site Safety and Health Program. The Certified Industrial Hygienist (CIH) is responsible for the following safety and health related activities at the site:

- Making changes or modifications to this SSHP, with concurrence of the Contracting Officer, as necessary throughout the project;
- Supervising the onsite Industrial Hygiene Technician (IHT);
- Overseeing the air monitoring program and evaluating results of air monitoring activities in regard to personal exposure;
- Determining the need for periodic audits of the operation to evaluate compliance with this program;
- Review all accident reports and conduct accident/illness investigations as warranted;
- Providing health and safety support as requested by the IHT and PM in accordance with this program;
- Maintaining the OSHA 200 for the site;
- Reviewing and approving this project health and safety program;
- Obtaining certification from the Occupational Physician each employee's ability to work in a potentially hazardous area, wear a negative pressure respirator, and wear protective clothing capable of producing heat stress; and
- This SSHP was prepared under the direction of John G. Danby, CIH. Mr. Danby is not available to participate in the above activities. His curriculum vitae is included in Attachment N for information purposes.

3.3 PROJECT MANAGER

The Project Manager (PM) shall direct onsite operations. At the site the PM, assisted by the Industrial Hygiene Technician (IHT), has primary responsibility for:

- Seeing that appropriate personal protective equipment, monitoring equipment, and facilities are available and properly utilized by all onsite personnel.
- Establishing that personnel are aware of the provisions of this plan, are instructed in the work practices necessary to enhance safety, and are familiar with planned procedures for dealing with emergencies.
- Establishing that all onsite personnel have completed a minimum of 40 hours of health and safety training and have appropriate medical clearance as required by 29 CFR 1910.120, and have been fit tested for the appropriate respirators.
- Seeing that personnel are aware of the potential hazards associated with site operations.
- Monitoring the safety performance of all personnel to see that the required work practices are employed.
- Correcting any work practices or conditions that may result in injury or exposure to hazardous substances.
- Seeing to the completion of Plan Acceptance forms by site personnel (see Attachment A).
- Halting site operations, if necessary, in the event of an emergency or to correct unsafe work practices.
- Completing the incident/accident report forms located in Attachment C immediately after an accident has occurred.
- Serving as a liaison with public officials and medical personnel.
- Reviewing and approving this project health and safety plan.

3.4 INDUSTRIAL HYGIENE TECHNICIAN

The Industrial Hygiene Technician (IHT) is responsible for site safety and health at the Carswell AFB site. The IHT will be onsite during all site activities to implement this SSHP during all hazardous activities. The IHT will work under the direct supervision of the Certified Industrial Hygienist, and is responsible for the following activities:

- Implementing and enforcing this Site Safety and Health Plan, and reporting any deviations from the anticipated conditions described in this plan to the CIH and PM.
- Enforcing disciplinary action when unsafe acts or practices occur.
- Conducting daily safety meetings, preparing site safety and health reports, and maintaining the safety and health records for site personnel.
- Granting permission for site access, controlling entry and exit points, maintaining site security, and maintaining exit and entry signs.
- Selecting the appropriate PPE for site personnel and periodically inspecting PPE for defects and proper maintenance.
- Monitoring site employees for heat and/or cold stress during work activities.
- Training employees on emergency procedures and evacuation routes, and providing follow-up training on the use of PPE.
- Enforcing the safety procedures outlined in this SSHP, and auditing compliance with this SSHP.
- Monitoring onsite hazards and conditions and making requests to the PM and CIH for revisions to this SSHP if conditions change or new hazards are found that were not previously covered.
- Evaluating the use of monitoring equipment by site personnel, seeing that it is calibrated in accordance with the manufacturer's instructions or other standards, and that results are properly recorded and filed.
- Implementing monitoring of site personnel as described in Section 7 and recording results of exposure evaluations.

- Enforcing the "buddy system" when working in remote locations, or working in areas where personal protective equipment is required.
- Setting up decontamination lines, controlling decontamination, preparing decontamination solutions, and disposing of contaminated materials.
- Dispensing PPE and seeing that PPE is available for site personnel.
- Identifying onsite personnel with special medical problems, such as allergies, physical limitations, or a perforated eardrum.
- Conducting daily safety meetings and completing the Site Safety Briefing Report (see Attachment F), also completing and submitting a weekly safety report to the Contracting Officer.
- Providing ongoing review of the protection level needs as project work is performed, and informing the PM and CIH of the need to upgrade/downgrade protection levels as appropriate.
- Maintaining a list of the hazardous chemicals brought onsite by contractors, and providing Hazard Communication training to site personnel to inform them of the hazards and health effects associated with the chemicals brought onsite by all contractors and subcontractors.
- Seeing that decontamination procedures listed in Section 12.0 are followed by onsite personnel.
- Halting site operations, if necessary, in the event of an emergency or to correct unsafe work practices.
- Notifying emergency response personnel in the event of an emergency.
- Reviewing and approving this site safety and health program.
- Obtaining a copy of Subcontractor's crane certification including load testing.

- Assuming any other duties as directed by the PM or CIH.

3.5 PROJECT PERSONNEL

Project personnel involved in onsite investigations and operations are responsible for:

- Taking all reasonable precautions to prevent injury to themselves and to their fellow employees.
- Performing only those tasks that they believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the IHT or PM.
- Implementing the procedures set forth in the Health and Safety Program, and reporting any deviations from the procedures described in the Program to the IHT or PM for action.
- Notifying the PM and IHT of any special medical problems they may have and seeing that other appropriate onsite personnel are aware of any such problems.
- Reviewing this site safety and health program and signing the acceptance form.

3.6 SUBCONTRACTOR'S SAFETY REPRESENTATIVE

Each subcontractor is required to designate a Subcontractor's Safety Representative (SSR), who typically is the subcontractor supervisor. The SSR is responsible for the safe and healthful performance of work by his work force and subcontractors. During the subcontractor's activities onsite, the SSR will perform continuing work area inspections, and conduct safety meetings and safety orientations for all new employees. The SSR will attend periodic safety meetings with the IHT. The SSR will also investigate accidents and overexposures involving subcontractor personnel. Each SSR is responsible for:

- Establishing that their onsite personnel are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and are familiar with planned procedures for dealing with emergencies.
- Establishing that their onsite personnel have completed a minimum of 40 hours of health and safety training, have completed an 8-hour refresher course within the last 12 months, (if appropriate), have appropriate medical clearance as required by 29 CFR 1910.120,

and have been fit tested for the appropriate respirators (all certificates are to be available on site).

- Seeing that their onsite personnel are aware of the potential hazards associated with site operations.
- Monitoring the safety performance of their onsite personnel to see that the required work practices are employed.
- Providing a copy of crane certification, including load testing to the IHT prior to the start of work.
- Correcting any work practices or conditions that may result in injury or exposure to hazardous substances.
- Preparing any accident/incident reports for their activities (see Section 14.1).
- Seeing to the completion of Plan Acceptance forms by their onsite personnel (See Attachment A).
- Halting their site operations, if necessary, in the event of an emergency or to correct unsafe work practices.
- Reviewing and approving this project health and safety plan.

4.0 HAZARD ASSESSMENT

4.1 CHEMICAL HAZARDS

From an occupational health standpoint, the levels of contaminants detected by previous site investigations are not expected to present a significant level of risk if the appropriate controls, as described in this SSHP, are properly implemented. Information from previous investigations indicate that the soil in the Flightline Ditch (SWMU 53) contains 99 to 3500 mg/kg of Total Petroleum Hydrocarbon (TPH) contamination, and soil in the Fire Department Training Area 2 (SWMU 19 and 20) contains less than 3500 mg/kg of Total Petroleum Hydrocarbons (TPH) and less than 50 mg/kg of benzene, toluene, and xylene.

Overviews of the hazards associated with exposure to the chemicals found onsite to date are presented below in terms of the following types of occupational exposure limits:

- PEL - Permissible Exposure Limit
- TLV - Threshold Limit Value
- REL - Recommended Exposure Limits
- STEL - Short Term Exposure Limit

OSHA Permissible Exposure Limits (PELs), ACGIH Threshold Limit Values (TLVs), and NIOSH RELs, which are expressed as time weighted averages (TWAs), are defined as concentrations for an 8-hour work day, 40-hour work week to which almost all workers can be repeatedly exposed without suffering adverse health effects.

Short Term Exposure Limit (STEL) is defined as the concentration to which workers can be exposed for short time periods without irritation, tissue damage, or narcosis sufficient to likely cause impairment of self-rescue or precipitate accidental injury. The STEL is a 15-minute time-weighted average that should not be exceeded at any time during the work day.

4.1.1 Contaminant Information

The primary contaminants found onsite during previous investigations are Jet Fuel #4 (JP-4) and constituents of JP-4 including benzene, toluene, ethyl benzene, and xylene. The hazards associated with both gasoline and kerosene are listed below.

Jet Fuel (JP-4)

Jet fuel #4 is comprised of 65-percent gasoline and 35-percent light petroleum distillate. The light petroleum distillate component of JP-4 resembles those associated with kerosene.

Gasoline

PEL/TLV = 300 ppm TLV-STEL = 500 ppm

Gasoline is an eye and throat irritant at levels around the PEL, and causes narcotic effects (with symptoms including headache, nausea, dizziness, and blurred vision) at higher levels. Long term exposure can effect liver and kidney function. Some studies indicate a potential for gasoline to be an animal carcinogen, but this has not been fully established. Because gasoline is a mixture of varying proportions of dozens of hydrocarbons, a mean odor threshold has not been determined.

Kerosene

REL = 100 mg/m³ (~14 ppm)

Inhalation produces effects typical of other lower molecular weight hydrocarbons, namely dizziness and nausea. Narcosis may occur at high exposure levels due to central nervous system depression.

When ingested, kerosene is moderately toxic (toxic dose low = 3570 mg/kg), producing distorted perceptions, coughing, nausea or vomiting, and fever. Aspiration of vomitus can cause serious pneumonitis.

Kerosene vapors are moderately explosive when exposed to heat or flame. Because kerosene is a mixture of varying proportions, a mean odor threshold has not been determined.

Xylene (o-, m-, p-isomers)

PEL/TLV = 100 ppm

REL = 100 ppm

STEL = 150 ppm

Xylene is an eye, nose and throat irritant at concentrations nearing 200 ppm. At higher concentrations, it is a central nervous system depressant, with symptoms including nausea, fatigue, and headaches. Liquid xylene acts on the skin as an irritant and can cause dermatitis. Exposure to vapor can cause eye irritation. Xylene is not considered carcinogenic. Xylene's mean odor threshold is 1 ppm, which gives it good warning properties. The ionization potential for the Xylene isomers are 8.56, 8.56, and 8.44 eV, respectively, and the vapor pressures range from 7 to 9 mm Hg.

4.1.2 Exposure Routes

The following potential exposure routes may exist at the site:

- Skin contact with contaminated materials.
- Inhalation of vapors or particulates.
- Ingestion of contaminated materials.

Skin contact with contaminated or potentially contaminated materials will be minimized by the use of personal protective clothing (as described in Section 6.0). Inhalation of vapors or particulates during remedial activities will be minimized by air monitoring and the use of engineering controls and respiratory protection if action levels are exceeded. Ingestion of contaminated materials will be minimized by the use of appropriate personal hygiene procedures during decontamination, including thoroughly washing face and hands with soap and water after leaving the work area and prior to eating, drinking, or using the restroom.

4.1.3 Exposure Risk Analysis

Field tasks on this project will include:

1. Demolition activities.
2. Excavation operations (including tilling of the biotreatment plot).
3. Use of powered hand tools.

4. Crane operations.
5. Truck driving and hauling operations.
6. Decontaminating field equipment.
7. Soil and area monitoring with a Organic Vapor Analyzer (OVA) and a Combustible Gas Indicator (CGI) during all invasive field activities.
8. General construction activities.

Table 4-1 entitled "Risk Analysis" summarizes the risk analysis associated with each of these tasks. Risk analysis is divided into three areas: exposure, probability, and consequence as presented in the columns on Table 4-1. The exposure column presents the expected frequency of exposure to a hazard. The consequence column presents the probable degree of injury should an injury occur. An explanation of the letters representing the degree of exposure, probability, and consequence follows the table.

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TABLE 4-1
RISK ANALYSIS

JOB HAZARD	EXPOSURE	PROBABILITY	CONSEQUENCE
Demolition Activities			
Equipment - mechanical	a	c	a-d
Equipment - noise	a	c	e
Chemical exposure	c	c	b-e
Excavation Activities			
Equipment - mechanical	a	c	a-d
Equipment - noise	a	b	e
Buried Utilities - electrical	c	c	a-d
Chemical exposure	a	b	b-e
Use of Powered Hand Tools			
Tools - mechanical	b	c	a-d
Tools - electrical	b	c	a-d
Tools - noise	b	c	e
Chemical exposure	d	d	b-e
Crane Operations			
Equipment - mechanical	c	c	a-d
Equipment - noise	c	d	e
Chemical exposure	d	d	e
Truck Driving and Hauling Operations			
Equipment - mechanical	b	c	a-d
Equipment - noise	c	c	e
Chemical exposure	c	c	e

Continued on following page

TABLE 4-1

RISK ANALYSIS
(Continued)

JOB HAZARD	EXPOSURE	PROBABILITY	CONSEQUENCE
Decontamination			
Steam Cleaner	b	c	b-d
Generator	c	c	c-d
Equipment - noise	b	c	e
Chemical exposure	b	c	b-e
Air Monitoring			
Chemical exposure	a	c	b-e
Biotreatment Cell Activities			
Equipment - mechanical	a	c	a-d
Equipment - noise	a	c	e
Chemical exposure	a	b	b-e
General Construction Activities (after remediation)			
Equipment - mechanical	a	c	a-d
Equipment - electrical	b	c	a-d
Equipment - noise	b	c	e
Chemical exposure	d	d	b-e

Key on next page

Key for previous tables

Exposure: The frequency of exposure to the hazard event.

- a. Continuously - many times daily
- b. Frequently - once or twice per day
- c. Occasionally - once/week to once/month
- d. Seldom - once/month to once/year

Probability: The likelihood that an injury will occur upon exposure to the hazard event.

- a. Certain or almost certain
- b. Likely, not usually, 50/50 chance of occurring
- c. Unusual, would happen less often than 50/50
- d. Improbable, not likely to happen

Consequence: The degree of injury resulting from exposure to the hazard event if an injury does occur.

- a. Fatality
- b. Serious injury, including chemical exposure, requiring hospitalization.
- c. Moderate injury, including chemical exposure, requiring outpatient medical treatment
- d. Minor injury, including chemical exposure, requiring on-site first aid.
- e. Chemical, acoustical, or other exposure above the Permissible Exposure Limits, or recommended standards such as Threshold Limit Value (TLV), that may not produce immediate acute health effects (especially for chronic toxicants).

TABLE 4-2

SUMMARY OF EXPOSURE STANDARDS, WARNING PROPERTIES, AND
ACUTE EXPOSURE SYMPTOMS FOR CHEMICALS OF CONCERN

Chemical	ACGIH TLV/TWA	OSHA PEL	NIOSH REL	IDLH	Odor Threshold	Hazard Properties	Acute Exposure Symptoms
Jet Fuel #4 (65%- Gasoline, 35% light petroleum distillate)	300 ppm (Gasoline)	300 ppm (Gasoline) *	Ca	---	ND	B,C,D,E,F	B,D,E,F,G
Benzene	10 ppm (A2) Pending change to 0.1 ppm	1 ppm (Ca)	0.1 ppm (Ca)	3000 ppm	34 ppm	B,C,D,E,F	B,D,E,F, G,L,M,N, Q
Toluene	100 ppm Pending change to 50 ppm	100 ppm	100 ppm	2000 ppm	3 ppm	B,C,D,E	B,D,E,F, K,N,O,P
Ethyl Benzene	100 ppm	100 ppm	100 ppm	2000 ppm	0.5 ppm	B,C,D,E	B,C,D,F, G
Xylene	100 ppm	100 ppm	100 ppm	1000 ppm	1 ppm	B,C,D,E	A,B,D,E, F,G

Key for previous chart

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Hazard Properties	Acute Exposure Symptoms
A - Corrosive	A - Abdominal Pain
B - Flammable	B - Central Nervous System Depression
C - Toxic	C - Comatose
D - Volatile	D - Headache, nausea, vomiting
E - Reactive/ Chemical Incompatibilities	E - Dizziness, staggering gait
F - Carcinogen	F - Dermatitis
G - Teratogen	G - Irritation of skin, eyes, nose, throat, respiratory tract
H - Reproductive Hazard	H - Fever
	I - Diarrhea
	J - Weakness
	K - Nervousness
	L - Anorexia
	M - Giddiness
	N - Fatigue
	O - Insomnia
	P - Euphoria
	Q - Carcinogen

ND = No Data

Ca = NIOSH and OSHA consider this chemical to be a potential human carcinogen and recommends the most protective respirators for exposure to this substance.

A2 = ACGIH considers this chemical to be a suspected human carcinogen.

Skin = There is the potential for significant contribution to the overall exposure through skin absorption.

***** = Gasoline PEL stayed by court decision.

TABLE 4-3

212032

SUMMARY OF PHYSICAL PROPERTIES OF CHEMICALS OF CONCERN

Chemical	Water Solubility	Specific Gravity	Vapor Density	Flash Point	Vapor Pressure	LEL - UEL
Jet Fuel #4 (65%-Gasoline, 35% light petroleum distillate)	Insoluble	0.72-0.76 (Gasoline)	3.0 - 4.0 (Gasoline)	-10 to 30°F (JP-4) -45°F (gasoline)	0.1 mm Hg at 20°C (Jet Fuels)	1.3% - 8.0% (JP-4)
Benzene	0.07%	0.88	2.77	12°F	75 mm	1.3% - 7.9%
Toluene	0.05% (61°F)	0.87	3.14	40°F	20 mm (65°F)	1.2% - 7.1%
Ethyl Benzene	0.01%	0.87	3.66	55°F	10 mm (79°F)	1.0% - 6.7%
Xylenes (o-, m-, p-isomers)	Insoluble	0.88/0.86/ 0.86	3.66	63/84/81°F	7/9/9 mm	1.0% - 7.0%

4.1.4 Hazard Communication

Materials which are considered hazardous materials under the OSHA Hazard Communication Standard may be used during this project for construction, decontamination or equipment calibration purposes. Copies of the MSDSs for such materials are included in the Attachment J. The IHT will make copies of these MSDSs available to any subcontractors on this project. Any material brought onsite that may be considered hazardous under OSHA regulations must first be cleared through the Industrial Hygiene Technician (IHT), so appropriate provisions can be made, if necessary, for compliance with the Hazard Communication Standard.

The following chemicals will be used onsite by site personnel:

- TSP or Alconox (decontamination)
- Gasoline (generator and equipment fuel)
- Diesel (equipment fuel)
- Simple Green (Degreaser)

All contractors are required to provide copies to the IHT of the MSDSs for all chemicals they bring onsite. A complete list of the hazardous chemicals brought onsite will be maintained and updated by the IHT whenever chemicals are added or deleted from the inventory.

The IHT is also responsible for providing Hazard Communication training to site personnel to inform them of the hazards and health effects associated with the chemicals brought onsite by all contractors and subcontractors. Training will also be updated when new chemicals are added to the chemical inventory list.

4.2 PHYSICAL HAZARDS AND CONTROL MEASURES

Physical hazards at this work site may include those associated with:

- Heat stress and cold stress;
- Slip-trip-fall type of accidents;
- Back injuries due to improper lifting;
- Being caught in or struck by moving heavy equipment;

- Noise from operation of fixed or mobile equipment;
- Trenching and excavation operations;
- Crane operations;
- Demolition operations;
- Operation of powered hand tools;
- Truck driving and hauling operations; and
- Electrocution or explosion hazards associated with excavation activities, such as contact with overhead or underground power lines or pipelines.

4.2.1 Heat Stress Recognition and Control

The wearing of Personal Protective Equipment (PPE) can place a worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, work load, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventive precautions are vital.

4.2.1.1 Signs, symptoms and first aid

Heat rash (prickly heat): may result from continuous exposure to heat or humid air. It appears as red papules (elevated skin lesion), usually in areas where the clothing is restrictive, and gives rise to a prickly sensation, particularly as sweating increases. It occurs in skin that is persistently wetted by unevaporated sweat. The papules may become infected unless treated.

First Aid for Heat Rash: to prevent heat rash: shower after work, dry off thoroughly, and put on clean, dry underwear and clothes. Try to stay in a cool place after work. If, in spite of this, you develop heat rash, see your physician.

Heat Cramps: are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

- muscle spasms
- pain in the hands, feet and abdomen

First Aid for Heat Cramps: leave the work area, and rest in a cool, shaded place. Drink one or two glasses of electrolyte replacement drink, and try to gently massage the cramped muscle. Once the spasms disappear, you may return to work; taking adequate breaks and drinking electrolyte replacement drink (about one cup every 20-30 minutes) should prevent the cramps from returning.

Heat exhaustion: occurs from increased stress on various body organs resulting from inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- pale, cool, moist skin
- heavy sweating
- dizziness
- nausea
- fainting

The key here is that the victim is still sweating, so the cooling system is still working; it's just under severe stress. The body core temperature should still be near normal. It is important to recognize and treat these symptoms as soon as possible, as the transition from heat exhaustion to the very hazardous heat stroke can be quite rapid.

First Aid for Heat Exhaustion: leave the work area immediately, go through decon and remove all chemical protective clothing. Rest in a cool, shaded place and open your clothing to allow air circulation; lay flat except when taking fluids. Drink plenty of cooled electrolyte replacement drinks. Your work is over for the day; do not resume work until you have been cleared by a physician for a return to work.

Heat stroke: is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:

- red, hot, usually dry skin
- lack of or reduced perspiration
- nausea
- dizziness and confusion
- strong, rapid pulse
- coma

First Aid for Heat Stroke: THIS IS A MEDICAL EMERGENCY! SUMMON MEDICAL ASSISTANCE IMMEDIATELY! Remove the victim from the work area, perform a gross decon, and remove all PPE. Have the victim lie down in a cool, shady area. Attempt to bring the victim's temperature down by increasing air movement (electric fan) or placing wetted sheets or towels on them. Place an ice bag on the victim's head. The victim must not be sent home or left unattended without a physician's specific order.

4.2.1.2 Heat stress prevention

The best approach to avoiding heat-related illnesses is through preventative heat stress management. The IHT is responsible for implementing this program.

Rest areas: a relatively cool, shaded area must be provided for breaks when ambient temperatures exceed 70°F and workers are wearing chemical protective clothing, or if temperatures exceed 85°F and workers are wearing "Level D" coveralls or work clothes. A car or van is an oven, not a rest area. The rest area should be located in the support zone adjacent to the contamination reduction zone situated so that part of it is in the decon area so workers can take breaks without going through full decon. If shade is not available, build some: use a plastic "dining canopy", which can be obtained at sporting goods stores. This same type of canopy can be set up to shade personnel performing manual labor in hot weather. See that the canopy is secured against the wind.

Liquids: employees are to drink cool electrolyte replacement drinks, such as Gatorade, Squench or Quik-kick (drink), frequently. Plain water is acceptable, but replacement drinks are preferred. OSHA prohibits a "community cup"; use disposable paper cups. Workers should drink 16 ounces of drink before beginning work, such as in the morning and after lunch. At each break, workers should take 8-16 ounces of drink. Don't wait until you are thirsty to drink.

Discourage the use of alcohol during non-working hours, and discourage the intake of coffee or other caffeinated beverages during work hours, as high caffeine intake makes heat stress control more difficult.

Acclimatization: this is the process by which the body "gets used to" hot work environments. This is achieved by slowly increasing workloads. Unacclimated personnel should start at 50 percent capacity on day one, and increase by 10 percent per day; on day six, they should be at 100 percent. One doesn't lose much acclimatization over a weekend, but it will start to decrease after three to four days in a cool environment. If hot work is not performed for a week, acclimatization is generally lost. Personnel don't have to do full shift hot work to achieve or retain acclimatization; a minimum of 100 minutes of continuous hot work exposure per day is adequate.

4.2.1.3 Heat stress monitoring

For field operations that are part of ongoing site work activities in hot weather, the following procedures shall be used to monitor the body's physiological response to heat, and to monitor the work cycle of each site worker. There are two phases to this monitoring: initial work/rest cycle determination, and physiological monitoring. The initial work/rest cycle is used to estimate how long the first work shifts of the day should be. Heart rate monitoring of each worker will establish the length of the successive work periods. This monitoring should commence when ambient (not adjusted) temperatures exceed:

- 70°F for personnel wearing chemical protective clothing, including Tyvek coveralls.
- 85°F for personnel wearing normal work clothes.

Determination of the initial work/rest cycles: Measure the air temperature with a standard thermometer with the bulb shielded from radiant heat; this yields T (actual). Estimate the fraction of sunshine by judging what percent time the sun is not shielded by clouds that are thick enough to produce a shadow. 100 percent sunshine - no cloud cover = 1.0; 50 percent sunshine - 50 percent cloud cover = 0.5; 0 percent sunshine - full cloud cover = 0.0.

Plug these variables into the following equation to determine the adjusted temperature:

$$T^{\circ}\text{F (adjusted)} = T^{\circ}\text{F (actual)} + (13 \times \% \text{ sunshine})$$

Use the chart below to estimate the length of the first work shift. At the first break, initiate the heart rate monitoring as described in the next section.

TABLE 4-4

INITIAL WORK/MONITORING CYCLES

<u>Adjusted Temperature</u>	<u>Normal Work Clothes</u>	<u>Protective Clothing</u>
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F (28.1°-30.8°)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

4.2.1.4 Heart rate monitoring

Heart rate (HR) should be measured by radial pulse for 30 seconds as early as possible in the resting period, preferably immediately after decon has been completed. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats per minute at the beginning of the next rest period, the following work period should be further shortened by 33 percent, while the length of the rest period stays the same.

4.2.2 Cold Stress Recognition and Control

Exposure to cold working conditions can result in cold stress (hypothermia) and/or injury (frostbite) to hands, feet, and head. Hypothermia can result when the core body temperature drops below 36°C (96.8°F). Lower body temperature will very likely result in dizziness, drowsiness, disorientation, slurred speech, or loss of consciousness, with possible fatal consequences. Pain in the extremities may be the first warning of danger to cold stress. Shivering develops when the body temperature has fallen to 35°C (95°F).

Hypothermia can be brought on by exposure to cold air, immersion in cold water, or a combination of both. Wind chill factor, the cooling power of moving air, is a critical factor in cold stress. The following table is an equivalent chill (ec) temperature chart relating actual air temperature to ec temperature at various wind speeds.

Adequate insulating clothing must be worn by workers if work is performed in ec temperatures below 4°C (40°F). At ec temperatures of 2°C (35.6°F or less), workers whose clothing becomes wet should be immediately provided with a change of clothing, and if necessary, treated for hypothermia. Treatment includes warming the victim with skin-to-skin contact, or by providing warm blankets or other coverings, and drinking warm liquids. Skin exposure should not be permitted at ec temperatures of -32°C (-25°F) or below.

If fine work is to be performed with bare hands for more than 10-20 minutes at ec temperatures below 16°C (60°F), provisions should be made for keeping the workers' hands warm. If ec temperatures fall below 40°F and fine manual dexterity is not required, then gloves should be worn. Metal handles of tools should be covered with insulating material at air temperatures below -1°C (30°F).

4.2.3 Walking and Working Surfaces

Workers should exercise cautions when walking around the site to avoid fall and trip hazards such as holes, pits, vaults, piping, etc. Open holes, pits, and vaults will be covered, fenced, or marked to warn workers.

4.2.4 Heavy Equipment/Construction Safety

The following safety guidelines shall be followed during all remedial and construction activities. The IHT and the SSR will continually inspect the work area for compliance with these safety guidelines.

4.2.4.1 Heavy Equipment Operations

Heavy equipment can represent a substantial hazard to workers. In general, requirements for motor vehicles and material handling equipment are provided in the Fed-OSHA Construction Safety Standard at 29 CFR 1926. The following safe work practices (SWP's) are recommended when heavy equipment is in use (front end/backhoe loaders, grading equipment, and so on):

- Use common sense. Do not assume that the equipment operator is keeping track of your whereabouts. Never walk directly in back of, or to the side of, heavy equipment without the operators knowledge.
- Hard hats, steel toe and shank boots, and safety glasses are to be worn at all times around heavy equipment. Other protective gear as specified in this health and safety plan is also applicable.
- Remain alert at all times.
- Maintain visual contact at all times.
- Establish hand signal communication when verbal communication is difficult. Determine one person per work group to give hand signals to equipment operators.
- Be aware of footing at all times.
- Only qualified/licensed people are to operate heavy equipment.
- Use chains, hoists, straps, and any other equipment to safely aid in moving heavy materials.
- Use proper personal lifting techniques. Use your legs, not your back.
- Never use a piece of equipment unless you are familiar with its operation. This applies to heavy as well as light equipment (i.e. chain saws).
- Pipe sections and other materials to be utilized during this project are extremely heavy. Make sure all precautions have been taken prior to moving heavy materials. Let the equipment, not your body, do the moving.
- Be sure that no underground or overhead power lines, sewer lines, gas lines, or telephone lines, will present a hazard in the work area.

- Keep all non-essential people out of the work area.
- Prohibit loose-fitting clothing or loose long hair around moving machinery.
- Keep cabs free of all non-essential items and secure all loose items.
- Instruct equipment operators to report to their supervisor(s) any abnormalities such as equipment failure, oozing liquids, unusual odors, and so on.
- When an equipment operator must negotiate in tight quarters, provide a second person to see that there is adequate clearance.
- Implement an ongoing maintenance program for all tools and equipment. Inspect all tools and moving equipment regularly to ensure that parts are secured and intact with no evidence of cracks or areas of weakness that the equipment turns smoothly with no evidence of wobble, and that it is operating according to manufacturer's specifications. Promptly repair or replace any defective items. Keep maintenance and repair logs.
- Store tools in clean, secure areas so that they will not be damaged, lost or stolen.
- Keep all heavy equipment that is used in the exclusion zone in that zone until the job is done. Completely decontaminate such equipment within the designated vehicle decontamination pad.
- Vehicles may not have cracked windshields or windows, and all glass used in windshields or windows shall be safety glass.
- Blades, buckets, dump bodies, and other hydraulic systems must be fully lowered when equipment is not in use.
- Parking brakes shall be engaged when equipment is not in use.

- All vehicles with rollover protective structures (ROPS) will have seat belts; operators will be trained in the use of seat belts, and the seat belts shall be used at all times during vehicle operation.
- With certain exceptions provided in 29 CFR 1926, Subpart O, all material handling equipment will be provided with ROPS.
- Equipment with an obstructed rear view must have an audible alarm that sounds when it is operating in the reverse direction (unless a spotter guides the vehicle operator).
- Material handling equipment that lacks a ROPS must not be operated on a grade, unless the grade can safely accommodate the equipment involved.
- A safety barrier will be used to protect workers whenever a tire is inflated, removed, or installed on split rims.
- Heavy equipment will be inspected by the operator prior to the beginning of each work shift, and the SSR and IHT shall ensure the compliance to this regulation.
- Traffic safety vests are recommended for personnel working near mobile heavy equipment, such as backhoes and other excavators.

4.2.4.2 Trenching and Excavation

All contractors are prohibited from entering a trench or excavation that is deeper than five feet without it being properly shored, sloped, or benched in accordance with 29 CFR 1926.650. If personnel are required to enter a trench or excavation that is deeper than five feet, the following provisions will be followed:

- The contractor must monitor the trench or excavation for hazardous atmospheres starting from a depth of 4 feet below ground surface if hazardous atmospheres are suspected;
- Shoring, sloping, or benching techniques must be employed;

- Means of employee access and egress must be utilized;
- A trained, competent person must inspect the trench or excavation on a daily basis, before work commences and on an as needed basis throughout the day.

A copy of the Federal OSHA Excavation Standard is located in Attachment K. All provisions of this regulation must be complied with when working in a trench or excavation that is deeper than five feet.

4.2.4.3 Crane Operation

Cranes used during this project will be inspected, operated, and maintained in accordance with 29 CFR 1926.550. It will be the responsibility of the subcontractor to ensure that the crane equipment is installed, inspected, tested, and operated in accordance with the manufacturer's specifications, ratings, limitations, operation and maintenance requirements, and applicable regulations. The crane must be certified as meeting Federal OSHA regulations. A copy of the crane certification, including load testing will be provided to the IHT prior to the start of work.

Load capacities, operating speeds, and any special warnings will be posted so that they are clearly visible to the crane operator or within reach of the operator. The operator will review load capacities and instructions before starting work. Load capacities will not be exceeded during operation.

Prior to onsite operations, the crane will be inspected and performance tested by the Contractor to demonstrate the equipment's ability to safely handle and maneuver loads. The Contractor will inspect the crane at the start of each shift to determine if it is in safe operating condition. Written records of inspections will be available for review by the CIH and IHT.

Only authorized, trained, qualified workers will operate the crane. Onsite instruction on site-specific concerns regarding the safe operation of the crane will be given to operators by the SSR and IHT prior to the start of work. Operators will be physically capable of operating cranes and will be able to read and understand signs, signals, and operating instructions. Operators observed to be under the influence of

drugs or alcohol will not operate the crane. The IHT will immediately halt any unsafe operation of the crane and report it to PM.

Cranes will not be raised in the vicinity of overhead electrical lines until the appropriate utility company has been notified and the electrical lines are certified by the utility company to be deactivated.

4.2.4.4 Powered Hand Tools

Only authorized trained workers will be allowed to use powered hand tools, and only after reviewing the manufacturer's safety procedures. All tools will be inspected by the operator prior to use and defective tools will be removed from service. Guards for moving parts are not to be removed. Electric-power tools will be double-insulated or grounded.

4.2.5 Noise Hazards

The primary noise hazard at this site is from the operation of construction equipment. Previous surveys indicate that such equipment may produce continuous noise at or above the action level of 85 dBA. All site personnel and visitors within 25 feet of operating equipment shall wear hearing protective devices (either muffs or plugs). Personnel are to wash their hands with soap and water prior to inserting ear plugs to avoid initiating ear infections.

4.2.6 Electrical Hazard Protection

All electrical work associated with this remedial activity is to be performed in compliance with the requirements outlined in 29 CFR 1910.300. Electrical subcontractors are responsible for following the provisions of this section as well as other applicable state or local electrical codes. Only qualified electricians should perform electrical wiring and installations.

4.2.6.1 Underground and overhead utilities

All contractors will make appropriate provisions to locate all underground utility locations prior to the commencement of excavating activities. Resources include site plans, utility companies, and utility locating services. The deactivation of utilities should be certified by the proper utility company personnel, and the certification retained in a permanent log.

Excavation operations adjacent to overhead lines shall not be initiated until operations are coordinated with the utility officials. Operations adjacent to overhead lines are prohibited unless one of the following conditions is satisfied:

- Power has been shut off and positive means have been taken to prevent lines from being energized; or
- Equipment, or any part of the equipment, does not have the capability of coming within the following minimum clearance from energized overhead lines, or the equipment has been positioned and blocked so that no part, including cables, can come within the following minimum clearances:

Power lines nominal system (kv)	Minimum required clearance
0-50	10 feet
51-100	12 feet
101-200	15 feet
201-300	20 feet
301-500	25 feet
501-750	35 feet
751-1000	45 feet

Ground fault interrupters (GFI) shall be used on all extension cords. All extension cords shall have a non-current carrying grounding conductor. Cords with damaged insulation shall not be used. If possible, equipment being repaired shall be locked and tagged out by the worker doing the repair. All portable tools shall be grounded or fabricated of approved, double insulated construction.

4.2.7 Work Area Protection

For project operations that are undertaken in a roadway or parking lot, motor vehicles may be a hazard. Guidance on properly coning and flagging the work area is located in Attachment H. Consideration should be given to parking a work vehicle within the coned area between the work area and oncoming traffic for additional protection.

5.0 RESPIRATORY PROTECTION PROGRAM

5.1 INTRODUCTION

This Section establishes the Carswell AFB Site Respiratory Protection Program. It establishes responsibilities and basic requirements for onsite personnel who are required to work in situations where respiratory hazards may be present. This Program was developed in accordance with the National Standards Institute (ANSI) Practices for Respiratory Protection (Z88.2) and the NIOSH Guide to Respiratory Protection.

All Site Contractors and subcontractors will provide approved and certified respirators and component parts to employees at no cost to the individual. Employees will use their respiratory protective equipment in accordance with this Procedure, and the instructions and training that are provided.

5.2 HAZARD EVALUATION FOR RESPIRATOR SELECTION

The IHT, under the direction of a Certified Industrial Hygienist (CIH), will evaluate Site operations, noting the chemical hazards present and the activities taking place. The IHT will estimate the health hazards associated with the chemicals and establish an exposure sampling strategy.

The IHT will use area sampling, personal sampling, or a combination of these to determine the level of exposure. If employees are exposed above the action level, the IHT will notify the PM; the IHT and PM will work to evaluate the feasibility of initiating the use of engineering controls, such as local exhaust ventilation, or administrative controls to reduce exposures. For further information on this process, reference Chapter 17 in Fundamentals of Industrial Hygiene, 3rd ed., National Safety Council, Chicago, IL, 1989.

5.3 RESPIRATOR SELECTION

The IHT or the CIH will select the appropriate type of respirator for a specific hazard. The selection of respiratory protective equipment will be based upon identification of the hazard, evaluation of the hazard, consideration of the user's personal characteristics, consideration of the conditions of use, and the use of an approved respirator.

The Respirator Flow Diagram located at the end of this Section provides guidance for respirator selection.

5.3.1 Identification of the Hazard

Identification of the type of hazard is the first step in the selection of a respirator. Although the number of hazardous conditions which might require a respirator are virtually limitless, they will generally fall into one of the following four categories:

1. Gas or Vapor Contaminant
2. Particulate Contaminants
3. Combination of Contaminants
4. IDLH Atmospheres

Once a hazardous situation has been categorized into one of the four types of hazards above, an initial decision can be made concerning the general type of respirator that may be selected. A decision logic chart for respirator selection based on these four hazard types is at the end of this section. Based upon initial hazard evaluation information (see Section 4.0, HAZARD ASSESSMENT), most of the respiratory exposure hazards at the Carswell AFB Site are anticipated to fall into the category of Vapor Hazards.

5.3.2 Evaluation of the Hazard Level

The second consideration in selecting a respirator is the level or concentration of the hazard requiring the respirator. The concentration of the air contaminant and how it compares to the TLV or PEL for that substance must be evaluated in order to determine the "protection factor" that the respirator must provide; this is the ratio of the concentration of the contaminant outside the respirator to that inside the respirator under conditions of use. Respirators should be selected so that the concentration inside the respirator will not exceed the TLV or PEL.

$$MUC = PF \times TLV$$

$$PF = MUC/TLV$$

Where MUC = maximum use concentration

PF = protection factor

TLV = threshold limit value

(or use PEL-permissible exposure limit).

Respirator protection factors tend to vary depending upon the specific standard cited. The list below presents protection factors that are generally accepted in the absence of standards that indicate otherwise.

PROTECTION FACTORS

Half-face filter or chemical cartridge respirator	10
Full-face filter or chemical cartridge respirator	50
Powered air-purifying respirator	100
Self-contained breathing apparatus, pressure-demand	10,000 +

Site activities that would require the use of supplied-air respiratory devices are not anticipated for this project.

5.3.3 Use of Approved Respirators

Only NIOSH/MSHA approved respiratory protective equipment is to be used at the Carswell AFB Site. Approved devices are listed in the NIOSH Publication, NIOSH Certified Equipment List. This publication is updated periodically with the addition of newly approved equipment and deletion of equipment which has lost its approval. All NIOSH-approved devices have a "TC" (Tested and Certified) number permanently printed on each item by the manufacturer; this number is referenced in the NIOSH Certified Equipment list described above.

In addition to only using approved devices, the wearer's medical, emotional, physical characteristics, and activities must be taken into account as part of an effective respiratory protective program.

The use of any type of respirator will impose some physiological stress on the user. Air-purifying respirators that are anticipated for this project make breathing more difficult because the cartridge or filter impedes the flow of air. Because the use of respirators does impose some physiological stress, wearers shall have medical examinations to determine if they are medically able to wear respiratory protective equipment without aggravating preexisting medical problems.

In order for the appointed Occupational Health Physician to render a qualified opinion on employee respirator usage, the physician should be provided with information about the employee's work activities and the type of respiratory protection to be used.

Scars, hollow temples, very prominent cheekbones, deep skin creases, and lack of teeth or dentures may cause respirator facepiece sealing problems. Additionally, since some individuals feel claustrophobic when wearing respirators, individuals who suffer from chronic claustrophobia should not be placed in situations requiring respirator use.

If glasses or goggles are required, they shall be worn so as not to effect the respirator. If a full-facepiece respirator is worn, a proper seal cannot be established due to the eyeglasses temple bars extending through the sealing edge of the facepiece. Systems have been developed for mounting corrective lenses inside full facepieces; and when a person must wear corrective lenses, the proper facepiece and lenses must be obtained to provide good vision, comfort, and a gas-tight seal. Wearing contact lenses with any type of respirator, however, is not permitted.

If the air contaminant can cause eye irritation, or if there is a potential for exposure to extreme skin irritants or skin-absorptive substances, a full facepiece respirator should be used. Also, rubber facepiece material can cause skin irritation dermatitis for some individuals; the use of non-allergenic silicone facepieces can help alleviate this condition.

Work time usually determines the period for which respiratory protection is needed, including time necessary to enter and leave a contaminated area. A chemical cartridge respirator provides respiratory protection for relatively short periods. Particulate-filter respirators can provide protection for long periods, without need for filter replacement, but only if the atmospheric particulate loading is low. Most chemical-cartridge respirators have no indicator of remaining service life. Canisters and cartridges should be changed according to the manufacturer's directions, or when breathing resistance or contaminant breakthrough occurs.

The work area to be covered, work rate, and mobility of the wearer in carrying out the work should be considered in respirator selection. Air-purifying respirators present minimal interference with the wearer's movement, but the high breathing resistance of air-purifying respirators under conditions of heavy work can result in distressed breathing. The wearer's work rate determines his respiratory minute volume, maximum inspiratory flow rate, and inhalation and exhalation breathing resistance. The respiratory minute volume is of great significance in self-contained and airline respirators operated from cylinders since it determines their operating life; it is also a factor in cartridge service life on air-purifying respirators. Useful life under moderate work conditions may be one-third of that under rest conditions.

The major problems in using respirators at low temperatures are freezing of exhalation valves (which can allow air contaminants inside the facepiece), and, for full face respirators, poor visibility due to fogging. Anti-fog compounds may be used to coat the inside of the lens to prevent fogging at room temperatures and down to temperatures approaching 32° Fahrenheit (°F). Full-face respirators are available with nose cups that direct moist exhaled air through the exhalation valve to prevent fogging. Selecting and using respirators having minimum weight and breathing resistance will minimize the additional stress imposed upon a person working under high temperature conditions.

5.4 MEDICAL SURVEILLANCE

No employee will be assigned to a task that requires the use of a respirator unless it has been determined that the person is physically and psychologically able to perform the task using an appropriate respirator. This determination will be made on an annual basis by the designated Occupational Health Physician. All site personnel using respiratory protective equipment must participate in the site Medical Surveillance Program. In baseline and subsequent medical examinations, participants will undergo a pulmonary function test; the results of this exam will be reviewed by the Occupational Health Physician to determine the participant's fitness for use of respiratory protective equipment. All USCAE personnel and visitors must provide proof of medical fitness or clearance to the CIH prior to being fit tested or being provided as respirator. The components of the various examinations are described in Section 11.0, MEDICAL SURVEILLANCE PROGRAM.

Some factors that may impose hardships on an employee required to wear respiratory protective include physiological stress due to increased breathing resistance, pulmonary impairment, cardiovascular disease, and other health problems such as diabetes, epilepsy, alcoholism, use of certain medications, punctured ear drum, skin sensitivities, impaired sense of smell, or any other factor which the Occupational Health Physician determines to place the individual at increased risk.

5.5 RESPIRATOR FIT TESTING

Fit testing is required by OSHA and ANSI. Each respirator user shall undergo a fit test in order to select the specific type, make, and model of negative pressure respirator for use by that individual. The following policies shall be observed in the fitting and use of the respirator:

- Fit tests will be repeated at least annually.

- Personnel shall be allowed to use only the specific make(s), model(s) and size of air purifying respirators for which the person has obtained a satisfactory fit verified through fit testing procedures.
- The IHT will keep records of the make, model, size, and type of respirator for which each onsite employee has been fit tested. The record will include the date and signature of the person performing the test.
- No facial hair or glasses are allowed that will interfere with the attainment of a good seal. Limited facial hair, such as regulation-military moustaches, that does not interfere with a good facepiece-to-face seal may be permissible. However, beards, even a one day growth of facial hair, are not permitted for personnel who will work in the Exclusion Zone or Contamination Reduction Zone.
- Contractors will provide their personnel requiring glasses with special glasses that mount inside the full face mask. Under no circumstances will contact lenses be worn while using any type of respirator.
- If it is found that an employee cannot obtain a good facepiece-to-face seal because of facial features or medical factors, respirators shall not be used and the employee shall not enter an atmosphere requiring the use of respirators.

Each employee who uses a respirator will receive qualitative fit-testing which involves negative and positive pressure sealing check for facepiece fit. The qualitative fit-test procedures also involves exposure of the respirator wearer to a test atmosphere using both isoamyl acetate (banana oil) and irritant smoke (stannic chloride) while various exercises are performed by the respirator wearer in the test chamber. The individual must obtain a satisfactory fit test (no detectable inward leakage of the test agents) to pass the qualitative fit test.

5.6 TRAINING

Although equipment selection is important to the success of a respiratory protection program, the proper use of the equipment is equally important. Proper use can be ensured by carefully training employees in the selection, use, and maintenance of the provided respiratory equipment. Respiratory protection training is a part of the initial and annual refresher training for hazardous waste site workers required under OSHA standard 29 CFR 1910.120 for Hazardous Waste Site Operations. The IHT or

CIH will provide respirator training to authorized USCAE personnel and visitors. The training will cover at least the following topics:

- Carswell AFB Site Respiratory Protection Program
- Overview of Respiratory Protection
- Physiology of the Respiratory System
- Classification of Respiratory Hazards
- Air-Purifying Respirators
- Respirator Selection, Use and Limitations
- Fit testing, maintenance and cleaning

5.7 INSPECTION, MAINTENANCE, CLEANING, AND STORAGE

Respirator maintenance is an integral part of any comprehensive Respiratory Protection Program. Wearing a poorly maintained or malfunctioning respirator is, in one sense, more dangerous than not wearing a respirator at all because workers wearing defective devices think they are protected when in reality they are not. It is the responsibility of the PM and/or IHT to evaluate compliance with inspection, cleaning, maintenance, and storage requirements. The program requires at a minimum:

- Inspection for defects, including a leak check.
- Repair as required.
- Cleaning and disinfecting.
- Proper and sanitary storage of equipment.

The maintenance program should provide each worker with a respirator that remains as effective as when it was new.

5.7.1 Inspection For Defects and Maintenance

If properly performed, inspections will identify damaged or malfunctioning respirators before they can be used. The OSHA standard outlines two types of inspections:

- Before and after use.
- During cleaning.

All respiratory equipment will be inspected thoroughly during the cleaning process and before the apparatus is used, and any defects will be repaired or the defective part replaced. Proper inspection, maintenance, and cleaning of respiratory equipment is the responsibility of the user. Detailed inspection procedures follow.

5.7.1.1 Respirator inspection procedures

Air purifying respirators: Air-purifying respirators should be checked as follows before and after each use:

Examine the facepiece for:

- Excessive dirt.
- Cracks, tears, holes, or physical distortion of shape from improper storage.
- Inflexibility of rubber facepiece (stretch and knead to restore flexibility).
- Cracked or badly scratched lenses in full facepieces.
- Incorrect mounted full facepiece lenses, or broken or missing mounting clips.
- Cracked or broken air-purifying element holder(s), badly worn threads, or missing gasket(s) if required.

Examine the head straps or head harness for:

- Breaks.
- Loss of elasticity.
- Broken or malfunctioning buckles and attachments.

- Excessively worn serrations on head harness, which might permit slippage (full facepieces only).

Examine the inhalation and exhalation valves for the following after removing its cover:

- Foreign material, such as detergent residue, dust particles, or human hair under the valve seat.
- Cracks, tears, or distortion in the valve material.
- Improper insertion of the valve body in the facepiece.
- Cracks, breaks, or chips in the valve body, particularly in the sealing surface.
- Missing or defective valve cover.
- Improper installation of the valve in the valve body.

Examine the air-purifying element for:

- Incorrect cartridge, canister, or filter for the hazard.
- Incorrect installation, loose connections, missing or worn gasket, or cross threading in the holder.
- Expired shelf-life date on the cartridge or canister.
- Cracks or dents in the outside case of the filter, cartridge or canister, indicated by the absence of sealing material, tape, foil, etc., over the inlet.

5.7.2 Cleaning

Cleaning and sanitizing of the units is accomplished in the following manner:

- The apparatus is broken down into its components as described in the manufacturer's schematic display that accompanies the unit. This step also affords the opportunity to thoroughly inspect each of the components for any defects, excessive wear and tear, and so on. Discard any previously used cartridges.
- Thoroughly wash the facepiece and mask components in a cleaning and sanitizing solution, such as 1 ounce of powdered MSA Cleaner-Sanitizer to 1 gallon of warm water (120°F). The components should be scrubbed with a sponge or soft brush to remove dust, dirt, or other contaminants.
- Thoroughly rinse all component pieces in warm water. This step is important because residuals of cleaning solutions can cause irritation and/or dermatitis for some individuals.
- Air dry all components thoroughly, inspect them again for any defects, reassemble the units, and store properly until the next use.

5.7.3 Storage

Respirators will be stored in a convenient, clean and sanitary location to protect them against dust, sunlight, excessive heat or cold, excessive moisture, damaging chemicals and mechanical damage. They will be stored individually, (for example, not stacked one upon the other or in cramped spaces) to prevent distortion of rubber or other elastomeric parts. Respirators should be stored in plastic bags, preferably in the cartons in which they came, and will be marked to readily identify the individual to whom it has been assigned.

5.8 PROGRAM EVALUATION

In compliance with 29 CFR 1910.134 and ANSI Z88.2, the Site Contractor will evaluate its Respiratory Protection Program effectiveness regularly so that all persons involved are being provided with the best respiratory protection possible. This will be accomplished through the IHT, with oversight by the CIH, and follow-up training will be provided at least weekly on any problems concerning respiratory protection observed during the previous week.

The IHT will perform spot inspections of respirator use to evaluate whether: the proper types of respirators are being used for the job; that employees properly perform positive/negative pressure fit tests prior to entering contaminated areas; individuals who are required to wear respirators have received proper training; respirators are inspected and maintained properly; respirator storage is satisfactory; respiratory hazards are monitored; the respirators being used are in good operating condition; and medical and biochemical surveillance of the respirator user is being carried out. They will also periodically consult with respirator users about respirator comfort, interference to breathing, interference with job performance, and their confidence in respirator effectiveness.

To evaluate the continued need for respiratory protection or a necessity for additional protection, there will be appropriate surveillance of the work area and the degree of employee exposure or stress, including area and personal monitoring of contaminant levels and types.

Data obtained from periodic inspections of respirator use, work area surveillance, medical surveillance, and wearer comments will be reviewed and analyzed to evaluate the continued effectiveness of the program. Any evidence of excessive exposure to a hazardous atmosphere will be investigated and action taken to remedy the problem.

6.0 PERSONAL PROTECTIVE EQUIPMENT PROGRAM

6.1 INTRODUCTION

The purpose of personal protective equipment (PPE) required during the Carswell AFB site activities is to shield individuals from the chemical hazards that may be encountered during site work. This chapter discusses the types of PPE that will be utilized during the project and outlines general levels of PPE to be used. In this chapter, PPE refers to that equipment which offers skin and body protection. Respiratory protection is covered as a separate category in Section 5.0.

6.2 PERSONAL PROTECTIVE EQUIPMENT STANDARDS

Some pieces of protective equipment such as hardhats, boots, safety glasses, and respirators have specific standards for manufacture and only those items meeting these standards should be used. However, there are no such standards for much of the chemical protective clothing used for field activities, and selections must be based upon experience, manufacturer's information, and reports in the literature. The following requirements pertain to the more common types of PPE.

6.2.1 Eye Protection

If work tasks are performed that can potentially harm the eyes, operations that may involve splashing, release of projectiles, or release of sufficient vapors or dusts as to cause an eye irritation problem, eye protection shall be worn. When working conditions require the use of a full-face respirator, the respirator provides protection for the eyes and face. However, if respiratory protection is not required, then safety glasses with side shields are used to provide eye protection. Safety goggles or a combination of safety glasses and faceshield is preferable for liquid hazards.

Common prescription glasses are sometimes called "safety glasses," but they are not the industrial quality glasses required by the current standard, ANSI Z87.1. Non-safety prescription eyeglasses are not permitted for use as eye protection at the Carswell AFB site. Non-safety prescription eyeglasses may be used only if covered with safety goggles or a face shield. Prescription eyeglass inserts may be worn under a full-face respirator. If prescription safety glasses are required, the cost of the frames and lenses should be reimbursable under the employer's health and safety program. The cost of the eye examination is usually borne by the employee or the employee's medical plan. Individuals whose vision is not correctable with

prescription eyeglasses are handled on a case-by-case basis. These individuals should contact the CIH or IHT.

Contact lenses shall not be worn: (1) in the exclusion zone or contamination reduction zone; (2) in conjunction with respiratory protection; or, (3) in areas and operations with potential for contact with eye irritants. Contact lenses may be worn for administrative activities in the support zone, providing that the activities preclude contact with site contaminants.

If lasers are used at the site, special protective safety glasses are required for those individuals who may come in contact with the laser beam.

6.2.2 Hearing Protection

Ear plugs or muffs will be worn by personnel who are required to perform tasks around backhoes, tractors, compactors, heavy machinery, compressors, impact tools, and similar equipment which produce high noise levels. The requirements of the OSHA noise standard must be followed, especially in the case of long-term site activities in high noise areas. Ear protection must comply with OSHA 29 CFR 1910.95. Good hygiene in the use of ear protection must be carefully considered to avoid initiating ear infections and because of the increased potential of chemical constituents being introduced into the ear.

6.2.3 Foot Protection

Foot protection, including leather work boots and chemical resistant boots, worn during site activities must meet the specifications of ANSI Z41-1983 and OSHA 29 CFR 1910.136. The material used to make the boots is not subject to any standards. For field activities at this site, the boots must have steel toes and shanks. Protection against liquid hazardous chemicals requires a boot constructed of an elastomer for chemical resistance.

6.2.4 Hand Protection

Glove selection for the Carswell AFB site is based upon requirements for dermal protection against JP-4 and BTEX. In areas where it is likely that JP-4 or BTEX will be encountered, the glove materials of choice are a nitrile inner glove topped with a butyl outer glove.

Gloves must resist puncturing and tearing as well as provide the necessary chemical resistance. In many instances, particularly when protecting against concentrated source materials, gloves may have to be layered. In this case, gloves are referred to as "inner" gloves, and "outer" gloves. Heavy leather gloves may be worn over chemical protective gloves when doing heavy work which could tear the chemical glove. If they become contaminated, leather gloves should be discarded because leather is difficult to decontaminate.

When selecting gloves, the thickness and cuff length will be taken into consideration. The thicker and longer the glove, the greater the protection. However, the glove should not be so thick that it interferes with dexterity.

6.2.5 Taping of Joints

Boots and gloves are generally taped to the protective garment in order to reduce the possibility of contaminants flowing into them. Duct tape is used in most instances. However, the taped joint is not a chemical barrier. The rule of taping is that the protective garment is taped over the glove or boot so that contaminants do not flow in. However, if a significant amount of "over the head" work will be done, consider taping the glove over the garment sleeve. Glove selection for specific tasks will be performed by the IHT or CIH.

6.2.6 Head Protection

The hardhat, a basic piece of safety equipment used in many work operations, must meet ANSI Z89.1-1969 and OSHA 29 CFR 1910.135 specifications. Manufacturers have adapted hardhats so that ear protection and faceshields may be easily attached. Hardhats are adjustable so that a helmet liner can be worn during cold-weather. A chin strap is advantageous when work involves bending and ducking. It also helps secure the hardhat to the head when full-face respirators are worn.

Faceshields that attach to hardhats provide added protection. A combination that leaves no gap between the shield and the brim of the cap is best because it prevents overhead splashes from running down inside the faceshield. The faceshield must meet ANSI Z89.1-1968 specifications.

Hardhats are to be worn at all times while in the exclusion, contamination reduction, or support zones at the Carswell AFB site, except when indoors.

6.3 SELECTION OF PERSONAL PROTECTIVE EQUIPMENT

The selection of the types of PPE to be used at the Carswell AFB site are based upon the most current data available concerning the chemical constituents found at the site, their concentrations, their chemical and physical properties (see Section 4.0, "HAZARD ASSESSMENT"), and the site activities. The general levels of protection assigned to task-specific activities have also been selected on best available data. The PPE level may vary with the scheduled activities or from activity to activity within a specific project task, based upon the work involved and any updated information made available during the project. Based upon the information available, the following types of PPE will be used throughout the project:

- Butyl outer gloves
- Nitrile inner gloves
- Chemical resistant steel toe, steel shank boots, such as LaCrosse Neoprene or Bata Superpoly
- Saranex Coated Tyvek coveralls*
- Hard hat, ANSI Z89.1-86 class A, B, and C compliant
- Safety glasses with sideshields, ANSI Z87.1-89 compliant
- Splash/impact goggles, ANSI Z87.1-89 compliant
- Leather work boots, steel toe and shank
- Work gloves, cotton or leather

* Note: Corps of Engineer project documents stipulate that Saranex Coated Tyvek coveralls will be worn at the site. It is the opinion of the health and safety professionals preparing this health and safety plan that regular (non-coated) Tyvek coveralls will provide adequate protection for most site operations and decrease the likelihood of heat stress disorders occurring.

The above list is to serve as a guide when evaluating the PPE requirements of each task/work area. Respiratory protective devices are discussed in Section 5.0. The levels of protection may be upgraded or downgraded, as site conditions change, remediation progresses, or as monitoring results indicate. The decision to upgrade or downgrade PPE will require the approval of the CIH or IHT. Under no circumstances will it be allowable to downgrade without the approval of these individuals. Decisions will be made using professional judgement based on evidence of exposure, chemical constituents, meteorological factors, activities involved, and other relevant factors.

6.4 INSPECTION, STORAGE AND MAINTENANCE OF PERSONAL PROTECTIVE EQUIPMENT

6.4.1 Inspection

The Personal Protective Equipment inspection program applies mainly to protective garments. Inspection of respiratory protection devices is described in Section 5.7. Inspections include:

- Inspection of garments as they are issued and/or prior to field use.
- Inspection after use.
- Periodic inspection of stored equipment.
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

Each inspection will cover somewhat different areas in varying degrees of depth. For disposable garments, the inspection steps outlined in Figure 6-1 will be used before and during use. Reusable garments will be subjected to the "before use" inspection after they are fully decontaminated. Any garment that is found to be defective in pre- or post-use inspection will be discarded.

6.4.2 In Use Monitoring

The inspections described in Table 6-1 represent one method of evaluating whether protective garments will perform as expected. It is equally important for the wearer to understand all aspects of protective equipment operations and its limitations. Field personnel should immediately report any perceived problems or difficulties to the IHT or the PM. These problems include, but are not limited to:

- Degradation of the protective ensemble (e.g., tears, punctures, discoloration, cracking, blistering).
- Perception of odors.
- Skin irritation.
- Unusual residues on PPE.
- Discomfort.
- Fatigue due to PPE use.
- Interference with vision or communication.
- Restriction of movement.
- Symptoms such as rapid pulse, nausea, and chest pain.

6.4.3 Storage

Clothing and respirators must be stored properly to prevent damage or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact. Many equipment failures can be directly attributed to improper storage. The following are guidelines for proper storage of personal protective equipment.

- Potentially contaminated clothing should be stored in an area separate from street clothing.

- Potentially contaminated clothing should be stored in a well-ventilated area, with good air flow around each item if possible.
- Different types, sizes, and materials of clothing and gloves should be stored separately to prevent issuing the wrong material by mistake.
- Protective clothing should be folded or hung in accordance the with manufacturers' recommendations.
- Garments should be stored in the original carton until their use.
- Small quantities of garments to be used at the site should be stored in plastic bags.
- Reusable items, such as hardhats, goggles and boots, must be fully decontaminated prior to being returned to storage or to the office.
- PPE is not to be stored in areas where it can come into contact with chemicals.

6.4.4 Maintenance

Maintenance of respiratory protection devices is described in Section 5.7. Maintenance requirements for other PPE items used at the Carswell AFB site is limited, as most items are either disposable, will be discarded upon failure, or will be returned to the manufacturer for maintenance. The IHT will identify maintenance guidance for any items of personal protective equipment requiring onsite maintenance.

6.5 WORK MISSION DURATION

For Carswell AFB site field operations, particularly those requiring higher levels of protection, there are several factors that must be considered when selecting PPE, and when determining the lengths of time for each segment of the work mission. These factors include:

- Suit/ensemble permeation and penetration by chemical constituents
- Ambient temperature
- Coolant supply

6.5.1 Suit/Ensemble Permeation and Penetration

Most Carswell AFB site operations are not anticipated to involve situations where the protective clothing will be challenged by prolonged chemical contact from splashes or high vapor concentrations. However, some operations may expose protective clothing to situations which would make the possibility of chemical permeation or penetration of the protective ensemble a matter of concern that may limit mission duration. Some possible causes of ensemble penetration are:

- Suit fastener leakage if the suit is not properly maintained or if the fasteners become brittle at cold temperatures.
- Imperfect seams which allow openings in the suit.
- Tears or punctures in suits, boots or gloves.
- Respirator exhalation valve leakage at excessively hot or cold temperatures.

When considering mission duration, it should also be remembered that no single clothing material is an effective barrier to all chemicals or combinations of chemicals. Also no material can be expected to be effective indefinitely to against prolonged chemical exposure.

The garment manufacturer's literature should always be consulted to determine whether a specific garment provides appropriate protection against a specific chemical. There is almost always some professional judgement involved in selecting PPE materials for a particular operation, particularly since most guides reflect a material's response to a challenge chemical at 100 percent strength. The CIH must always be consulted regarding the selection of PPE materials.

6.5.2 Ambient Temperatures

The ambient temperature has a major influence on work mission duration as it affects both the worker and the protective integrity of the ensemble. Heat stress, which can occur even in relatively moderate temperatures, is one of the greatest immediate dangers to a worker wearing PPE. Methods to monitor for and prevent heat stress are discussed in Section 4.2.1. Hot and cold ambient temperatures also affect:

- Valve operation on respirators
- Durability and flexibility of suit materials
- Integrity of suit fasteners
- Breakthrough time and permeation rates of chemicals
- Concentration of airborne contaminants

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All these factors may decrease the duration of protection provided by a given piece of clothing or respiratory equipment.

6.5.3 Coolant Supply

Under warm or strenuous work conditions, a cooling system may be used under the protective garment to keep the wearer's body at a comfortable temperature and to reduce the potential for heat stress. If a coolant such as ice or chilled air is necessary, the duration of the coolant supply will directly affect mission duration.

6.6 PPE TRAINING AND FITTING

6.6.1 Training

Training with use of PPE is required by 29 CFR 1910.120. Respirator training is addressed in Section 5.6. PPE training:

- Allows the user to become familiar with the equipment in a nonhazardous situation.
- Instills confidence of the user in his/her equipment.
- Makes the user aware of the limitations and capabilities of the equipment.
- Increases the efficiency of operations performed by workers wearing PPE.
- Reduces the expense of PPE maintenance.

Training will be completed prior to actual PPE use in site operations. The personal protective equipment segment of the OSHA 1910.120 training for Hazardous Waste Site Workers will satisfy this requirement. For visiting government personnel, the IHT or CIH will explain the selection, limitations, and proper use of the PPE for the task. The training portion of the PPE program will describe the user's responsibilities and explain the following, utilizing both classroom and field training when necessary:

- Proper selection of PPE.
- The proper use and maintenance of the selected PPE, including capabilities and limitations.
- The nature of the hazards and the consequences of not using the PPE.
- The human factors influencing PPE performance.
- Instruction in inspecting, donning, checking, fitting, and using PPE.
- The user's responsibility for decontamination, cleaning, maintenance, and repair of PPE.
- Emergency procedures and self-rescue in the event of PPE failure.
- The buddy system.
- The Health and Safety Plan and the individual's responsibilities and duties in an emergency.

The discomfort and inconvenience of wearing PPE can create a resistance to the conscientious use of PPE. One essential aspect of training is to make the user aware of the need for PPE and to instill motivation for its use and maintenance.

6.6.2 Follow-up Training

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The IHT or CIH will provide follow-up training at least weekly on any problems observed during the previous week such as improper use of respirators or protective clothing, violation of decontamination procedures, etc. Special training will also be provided when unanticipated problems or changes in site operations occur, and to new employees or government personnel as needed.

6.6.3 PPE Fitting

It is very important to have PPE that fits properly. Coveralls that are too tight restrict movement and may tear. Oversized gloves hamper dexterity. Employees should check their PPE prior to leaving the support zone to see that the fit is appropriate. Some points to remember include:

- Sizes differ between manufacturers and materials. For example, a size 8 neoprene glove will fit much tighter than a size 8 nitrile glove.
- A tight Tyvek coverall will rip out in the underarm, shoulders, back and crotch. When trying on a Tyvek, do some squats and shoulder shrugs to check for freedom of movement; if it's tight, move up a size.
- Do not tape the suit far down on the wrist or ankle. Allow enough slack in the arms and legs of the suit so that they don't tear when you move.
- For the smaller field person, strategically placed pieces of duct tape will shorten coverall legs and torsos to make the fit more comfortable.
- When sizing outer gloves, remember to make sure they fit over the surgical or other inner gloves as appropriate.
- If, in spite of your sizing efforts, you rip out a Tyvek coverall, leave the work area immediately and replace the garment (after appropriate decon). Duct tape patch-ups are not acceptable.

6.7 LEVELS OF PROTECTION

The following is a brief description of the levels of protection that may be utilized at the Carswell AFB site and the general types of PPE incorporated in each. Appropriate PPE from the lists below will be provided for up to three (3) government personnel on a daily basis. USCAE or visitor personnel must provide proof of medical fitness or clearance prior to being provided PPE capable of causing heat stress. With each of these levels of protection there is a degree of variability or modification dependant on the specific tasks, specific constituents, form and concentration of constituents involved. For example, different tasks in the same operational unit may require different levels of respiratory protection but retain the same clothing requirements. Variation to a level of protection may be indicated by a qualifier, such as "Modified Level D."

The two highest levels of protection, A and B, both rely on supplied-air devices to provide a high level of respiratory protection. Because Level A or B work will not be performed as part of this project, the following discussion will focus on Level C and Level D protection.

6.7.1 Level "C" Protection

Generally, Level C will be employed where skin contact with site constituents is not likely, and where the airborne exposure is primarily from low levels of fuel vapor constituents or airborne dusts. Level C is anticipated to be the highest level of protection necessary because of the concentration levels of site contaminants and site activities. The Level C personal protective equipment for the Carswell AFB site includes:

- Air-purifying respirator (full-face) with either organic vapor cartridges or combination organic vapor/HEPA cartridges
- Disposable, one-piece Saranex Tyvek® coverall
- Nitrile inner gloves
- Butyl outer gloves
- Chemical resistant boots with steel toe and shank
- Hard hat

- Hearing protection

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- Additional Equipment (as warranted by conditions):

1. 2-way, intrinsically safe radios
2. long cotton underwear
3. coveralls
4. safety glasses or goggles
5. face shield
6. rain gear

6.7.2 Level "D" Protection

This is a field work uniform affording a lower level of protection. Level D can be employed in areas where there are no contaminants present, or contaminants are present below the action levels established in this SSHP for respirator use. In addition, the work functions must preclude splashes, immersion, or potential for unexpected inhalation of any chemicals. The Support Zone and remediated areas are examples of where this level of protection will be employed. The Level D personal protective equipment for the Carswell AFB site includes:

- Disposable, one-piece Saranex Tyvek® coverall
- Nitrile inner gloves
- Butyl outer gloves
- Work Gloves (as required)
- Safety glasses, goggles, or faceshield
- Chemical resistant boots with steel toe and shank
- Hard hat
- Hearing Protection (as required)
- Rain Gear (as required)

6.7.3 Modified Level "D" Protection

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The Support Zone (or clean areas of the site) is where this level of protection will be employed. The Modified Level D personal protective equipment for the Carswell AFB site includes:

- Work Gloves (as required)
- Safety Boots, leather, or chemical resistant, with steel toe and shank
- Safety glasses, goggles, or faceshield
- Hard hat
- Hearing Protection (as required)
- Rain Gear (as required)

6.8 TASK-SPECIFIC PPE REQUIREMENTS

Table 6-1 provides the basic level of protection that will be applied during each field activity. It is based upon the general characteristics of the contaminants found and the type of remedial action to be performed. Specific activities or smaller work areas within the larger task areas may be assigned varying levels of protection that may differ from those presented here.

TABLE 6-1

BASIC TASK-SPECIFIC LEVELS OF PROTECTION

<u>Project Task/Activity</u>	<u>PPE Level</u>
Sampling Soils for Delineation	D/C
Removal of Impacted Soils, AST, Dumpster, and Liquid Contents	D/C
Excavation, Screening, and Truck Loading of Impacted Soils	D/C
Removal/Steam Cleaning of Rubble	D/C
Spreading Soils for Bioremediation	D/C
Tilling/Sampling Soils during Bioremediation	D/C
Backfilling, Grading, Compacting "Clean" Soils	D*
Final Confirmatory Sampling	D
Site Restoration/Reseeding	D*

* Denotes Modified Level D ensemble.

Note: Action levels are in Section 7.

6.9 DOFFING AND DONNING PROCEDURES

For most Carswell AFB site operations, PPE donning (suiting-up) procedures are relatively straight-forward, as the PPE involved is not complex. Regardless of the type of contamination present or the sophistication of the PPE, care must be taken during the PPE doffing (removal) sequence to ensure that contamination does not contact personnel and is not carried out of the work area. As doffing procedures are conducted in concert with decontamination, these operations are described in the section on Decontamination Procedures, 12.0. Sample PPE donning procedures follow.

6.9.1 Sample Donning Procedure For Level C Protection

Equipment used: Full-face air purifying respirator, hardhat, Saranex Tyvek coveralls, inner nitrile gloves, outer butyl gloves, chemical-resistant steel toed and shank boots, ear plugs or muffs, duct tape, hard hat.

- Inspect the clothing and respirator in accordance with the procedures previously described.

- Adjust the hard hat suspension to fit the user's head.
- Don the Saranex Tyvek coverall and secure all closures (zippers, and so on.)¹.
- Put on the boots, placing the leg cuffs of the coveralls over the boot.
- Tape the cuffs in place on the boots.²
- Put on the inner nitrile gloves.
- Put on the outer butyl gloves, place the coverall sleeves over the gauntlets of the gloves, and tape the cuffs in place.^{2,3}.
- Don the respirator, following the procedures in Section 5.0; perform the negative and positive respirator facepiece seal procedures.
- Put on the hardhat.
- Put on hearing protection.

¹ After donning the Saranex Tyvek coverall, move around to see if the coverall fits well; check for tightness in the crotch (squats) and shoulders (shrugs).

² Bend your arm/leg prior to taping to assure freedom of movement.

³ If a significant amount of "over the head" work will be done, the gloves should be taped over the coverall sleeves.

The IHT will evaluate the Personal Protective Equipment Program on a periodic basis or as directed by the CIH. Issues to be considered include:

- Accident-illness experience
- Levels of exposure
- Appropriateness of equipment selection
- Adequacy of the operational guidelines
- Adequacy of decontamination, cleaning, inspection, maintenance, and storage programs
- Adequacy and effectiveness of training and fitting programs
- Coordination with overall safety and health program elements
- Costs of the program
- The degree of fulfillment of program objectives
- The adequacy of program records
- Recommendations for program improvement and modification

Deficiencies in the use of the personal protective equipment will be corrected and retraining provided as outlined in Section 6.6.2.

TABLE 6-2

PROTECTIVE GARMENT INSPECTION PROCEDURES

CLOTHING

Before use:

- Determine that the clothing material is correct for the specific task at hand.
 - Visually inspect for:
 1. imperfect seams
 2. non-uniform coatings
 3. tears
 4. malfunctioning closures
 - Hold the garment up to light and check for pinholes.
 - Flex the garment and observe for:
 1. cracks
 2. brittleness
 3. other signs of on-shelf deterioration
 - If the product has been used previously, inspect inside and out for signs of chemical attack such as:
 1. discoloration
 2. swelling
 3. stiffness
 - During the work task, periodically inspect for:
 1. evidence of chemical attack such as discoloration, swelling, stiffening, and softening
 2. closure failure
 3. tears
 4. punctures
 5. seam discontinuities
-

Keep in mind, however, that chemical permeation can occur without any visible effects.

Inspection of reusable garments is of particular importance, as chemicals that have begun to permeate clothing during use may not be removed during decontamination and may continue to diffuse through the material towards the inside surface, presenting the hazard of direct skin contact to the next person who uses the clothing. However, for this project, disposable garments (Saranex® coveralls) will be used for all site activities, so continuing diffusion and resulting skin hazard are not anticipated to be an issue.

When inspecting gloves prior to use, pressurize the glove to check for pinholes. Either blow into the glove, then roll gauntlet towards fingers or inflate the glove and hold under water. (Do not blow into gloves with your mouth if they have been previously used) In either case, no air should escape.

Any worker who experiences a garment failure as listed in the "during the work task" section on the preceding pages is to immediately exit the work area, go through the decontamination process, and replace the garment. Duct tape repairs are not acceptable, as duct tape is regarded as having no resistance to chemical permeation or degradation.

Records must be kept of all inspections of reusable garments. At a minimum, each inspection should record the item, date, inspector, and any unusual conditions or findings. Periodic review of these records may indicate an item or type of item with excessive maintenance costs or a particularly high level of "down-time."

7.0 AIR MONITORING PROCEDURES AND ACTION LEVELS

7.1 AIR MONITORING INSTRUMENTS

The field instrumentation described in this subsection has been specifically selected for the contaminants that may be reasonably anticipated to be encountered during the course of this project. Selection factors include anticipated airborne concentrations, potential interferences, ionization potentials, instrument sensitivity, and occupational exposure limits. The action levels described below are established with the expectation that these specific instruments will be used. **DO NOT SUBSTITUTE INSTRUMENTS WITHOUT THE CONSENT OF THE CIH AND CONTRACTING OFFICER.**

A Foxboro-Century Organic Vapor Analyzer Model 108 (OVA) will be used to monitor for hydrocarbon vapors. The 108 has the required 1-10,000 ppm range; do not use a Model 128, which has a 1-1,000 ppm range. The analyzer will be used on a regular basis, typically every five to ten minutes, to monitor in the operator's breathing zone (OBZ) of personnel working in the vicinity of the excavation, dumpster removal, and tank purging operations. If readings exceed an average of 750 ppm for more than one minute, work will stop, and workers will move upwind while the vapors dissipate; if elevated levels remain for more than five minutes, the vapor source will be covered with clean soil, plastic sheeting, or foam, and the CIH will be contacted for further guidance. OVA readings must drop below 500 ppm in order for work to restart.

Direct-reading colorimetric tubes (Draeger tubes) will be used to semi-quantitatively confirm the presence or absence of specific contaminants. Note that the tubes specified by COE (Draeger 0.5/a) have a range of 0.5 to 10 ppm, but are not specific for benzene; all BTEX vapors are indicated with roughly equal sensitivity. Draeger tube measurements will be obtained in the OBZ of the person working nearest the source and will be evaluated in accordance with the following criteria:

- If OVA readings exceed 30 ppm, pull a tube sample in the OBZ.
- If OVA readings exceed 100 ppm, pull OBZ tube samples every 30 minutes.

Should tube readings exceed 0.5 ppm, workers are to don full-face air purifying respirators with organic vapor cartridges. If tube readings exceed 10 ppm, work will stop, and workers will move upwind while the vapors dissipate; if elevated levels remain for more than five minutes, the vapor source will be covered with clean soil, plastic sheeting, or foam, and the CIH will be contacted for further guidance.

Note that Level B PPE will not be used on this project.

A summary of the response criteria is presented below.

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(OBZ - Operator's Breathing Zone)

Analyzer Reading*	Location	Time Period	Action
< 100 ppm on OVA or < 0.5 ppm on tube	OBZ	-----	Continue in Level D Collect tube sample if OVA > 30 ppm
> 100 ppm on OVA or > 0.5 ppm on tube	OBZ	> 1 minute (OVA)	Don full-face respirators with organic vapor cartridges; Collect tube samples every 30 minutes. Use OVA to monitor at downwind support zone perimeter.
> 750 ppm on OVA or > 10 ppm on tube	OBZ	> 1 minute (OVA)	Stop work; move upwind while vapors dissipate. If elevated levels remain, cover hydrocarbon vapor source, evacuate upwind and notify CIH.
<u>Return to Work Criteria</u> < 500 ppm on OVA or < 10 ppm on tube	OBZ	> 1 minute	Resume work in PPE appropriate for the readings.
<u>Downwind Support Zone</u> > 10 ppm	Downwind support zone	> 1 minute	Use visqueen and clean soil to cover vapor source.

* above background readings

OVA readings are taken every 5 to 10 minutes

"Tube" refers to Draeger 0.5/a benzene tube

7.1.1 Explosive Atmospheres

The potential exists for explosive atmospheres at the site due to the presence of JP-4 which has a low flash point (-10°F to 30°F). A Combustible Gas Indicator/O₂ (CGI/O₂) meter will be used to monitor ambient conditions at all times during project operations involving JP-4 or JP-4-contaminated materials. Oxygen concentrations should be measured prior to taking combustible gas readings to determine that there is sufficient oxygen (> 10%) to operate the Combustible Gas Indicator. Decisions will be based on the Lower Explosive Limit (LEL) as determined by the Combustible Gas Indicator as follows:

LEL READING	ACTION
< 10% LEL	Continue Operations
10% - 20% LEL	Continue Monitoring
> 20% LEL	Shutdown operations and evaluate source, ventilate or "blanket" vapor source

Fire suppression equipment (Two 20-pound ABC fire extinguishers or fire hoses) is to be present at all times during project operations in areas where fire potential exists.

7.1.2 Personal Sampling Activities

COE specifications require personal monitoring for volatile aromatic hydrocarbons when OVA readings exceed 100 ppm or benzene detector tube readings exceed 0.05 ppm. National Institutes of Occupational Safety and Health (NIOSH) Method 1501 (aromatic hydrocarbons) will be used for monitoring in the breathing zone of exclusion zone personnel. Up to two people will be monitored per shift (concurrent monitoring) on an as required basis, with approximately 4 sampling episodes each. Multiple sampling episodes are preferred over one long single episode, as this permits improved correlation of worker exposure to other site data. Personal sampling pumps calibrated to a flow of 200 cc/min will draw air over a coconut shell charcoal tube for a period of 100 to 120 minutes (yielding 20 to 24 liters of air). This should provide a detection limit of approximately 50 ppb benzene. While such a volume will exceed the published breakthrough volume for toluene, achieving low limits of detection for benzene outweigh this potential problem. A copy of NIOSH Method 1501 is in Attachment M.

Personal sampling pumps will be calibrated against a primary standard bubble meter such as the Gilian "Giliberator" or equivalent microprocessor-controlled unit. Pre- and post-sampling calibration will be conducted with representative sampling train in place.

Samples will be analyzed by a laboratory accredited by the American Industrial Hygiene Association on a rush turnaround (24 hour) basis to permit written exposure reports to be prepared within three working days of the sampling episode. It is anticipated that C-Tek Environmental Health Laboratory in Dallas will be used to facilitate the turnaround requirements; a copy of C-Tek's AIHA Accreditation certificate is located in Attachment O. The CIH will immediately notify the Project Manager and the Contracting Officer if any exposure exceeds the 0.5 ppm benzene action level. The lab will be directed to provide a "total hydrocarbons" concentration for each sample submitted to permit the CIH to report any exposure that exceeds the gasoline TLV of 300 ppm as required by the COE specification. It should be noted a reasonable review of the literature indicates that the TLV for the bulk loading of gasoline has no bearing on the evaluation of potential exposures to JP-4; available resources would be best used by focusing on exposures to vapor-phase BTEX.

7.1.3 Sample Documentation and Reporting

The CIH/IHT will maintain a complete chronological record for each air sample obtained as described in Section 7.1.2. The record will include a chain of custody, calibration record, sample data sheet, and field log.

7.1.3.1 Chain of Custody

The Chain of Custody record documents the history of the sample from the time the identification number is assigned through shipment to the laboratory and final analysis. This record includes:

- Sample identification number;
- Sample wearer, location and activity;
- Date and time of sample collection;
- Sample type and NIOSH/OSHA Method number; and
- Signatures of personnel that handled the sample.

7.1.3.2 Calibration Record

A sequentially-numbered Calibration Record will be completed for each sampling pump/calibration event; the Record will include:

- Sample pump make, model and identification number;
- Calibrator make, model and identification number;
- Date and time of calibration;

- Targeted calibration point;
- Pre-and post-sample calibration results; and
- Signature of person performing the calibration.

7.1.3.3 Sample Data Sheet

A Sample Data Sheet will be completed for each sampling event, and will include:

- Unique sample identification number;
- Sample wearer's name, social security number, location and activity;
- Sample pump identification number;
- Relevant Calibration Record number;
- Pre- and post-sample calibration results;
- Type of sample and NIOSH/OSHA Method number;
- Sample date and start and stop time;
- Total sample volume;
- Temperature, barometric pressure, and relative humidity;
- Wind conditions during sampling intervals;
- References to location sketches or photos; and
- Name of IHT collecting the sample.

The IHT will keep a daily field log for all air samples collected; the field log will include:

- Unique sample identification numbers;
- Sample date;
- Sampling locations and operations;
- Type of sample and NIOSH/OSHA Method number;
- IHT/sampler's initials;
- Date samples were sent to lab;
- Date analytical results were received; and
- Date results were reported to the Contracting Officer.

7.1.4 Sample Quality Assurance and Quality Control

When the collection of integrated air samples, as described in Section 7.1.2, is required, the IHT will implement the following controls to provide results that are accurate, reliable, and representative of worst case conditions.

- In accordance with 29 CFR 1910.120 (h)(4), the IHT will monitor those employees likely to have the highest exposures to hazardous substances. Examples may include backhoe/tracker operators or personnel handling (by shovel or other hand implement) contaminated materials.
- Real-time monitoring equipment, such as the OVA or CGI/O₂ meter, will be calibrated as described in Section 7.3, below.
- As directed by NIOSH Method 1501, at least two field blank sorbent tubes will be submitted with each set of samples. These blanks are to be handled as if they were samples, except that they are to be capped immediately after the tube tips are broken; no air is to be drawn through the blanks.
- Quality control procedures will include careful calibration of the pump and sampling train (see 7.1.3.2), and observation of the sample collection parameters in Table 3 of NIOSH 1501 (Attachment M). Note that the COE spec required QC compliance with Appendix A of 29 CFR 1910.120; Appendix A is for leak-testing of fully-encapsulating suits, and has no bearing on personal sampling or any other aspect of this project.

- Samples will be packaged to prevent breakage prior to being transported to the industrial hygiene laboratory for analysis. Chain of custody procedures as described in Section 7.1.3.1 will be observed.
- The Contractor will maintain sample results, lab procedure data, and records associated with the procedures in Sections 7.1.3.1 through 7.1.3.4.

7.1.5 Additional Personal Monitoring

The IHT will conduct personal sampling in addition to that required by Section 7.1.2 under the following conditions:

- If an employee develops symptoms consistent with exposure to hazardous substances;
- If the Occupational Physician determines that more frequent sampling is necessary; or
- If the CIH, in coordination with the IHT and with concurrence of the Contracting Officer, determines that additional sampling is necessary.

7.2 OXYGEN DEFICIENT ATMOSPHERES

Oxygen deficient atmospheres may be encountered in tanks and/or excavations. Tanks and excavations are not to be entered unless absolutely necessary and then only after following appropriate confined space entry procedures. These procedures are available by contacting the CIH to obtain a confined space entry permit.

Prior to entering any space where an oxygen deficiency may exist, an oxygen meter will be used to test for adequate oxygen levels. Decisions will be based on oxygen concentrations as follows:

20.8%	Continue Operations
< 20.8 %	Continuous Monitoring
< 19.5 %	Do not enter, ventilate, and determine if supplied air equipment is required

COE specifications require monitoring be conducted to evaluate concentrations of air contaminants offsite. Available soil sampling results indicate that total BTEX in soil is less than 50 ppm. Under worst-case conditions, if all BTEX was at the vapor pressure of benzene, air concentrations at soil surface would not exceed 5 ppm. However, as the site is not fully characterized, the following perimeter monitoring criteria have been established.

If OVA monitoring results exceed 100 ppm in the OBZ, the downwind support zone perimeter will be monitored with the OVA on a regular (10-15 minute) basis. If readings exceed 10 ppm for more than one minute, the vapor source will be covered with soil and visqueen, and the active excavation moved to another location until vapor emissions are reduced below the 10 ppm downwind perimeter criteria.

7.4 MONITORING FOR METALS

Available data indicates that 20 mg/kg of lead (PEL 0.05 mg/m³) has been detected, as well as selenium at levels up to 70 mg/kg (PEL 0.2 mg/m³). For a 20 mg/kg concentration of lead in soil to approach the PEL in air, total dust concentrations would have to approach 2,500 mg/m³.

$$(1,000,000/20 \text{ mg/kg}) \times 0.05 \text{ mg/m}^3 = 2,500 \text{ mg/m}^3$$

Since this is, for all intents and purposes, virtually impossible, occupational health hazard associated with lead inhalation is negligible. Therefore, IH monitoring for metals will not be conducted.

7.5 BACKGROUND READINGS

All direct-reading instrument readings will be evaluated relative to background readings, not "meter zero". Prior to the start of work at each shift, and whenever there is a significant shift in wind direction, instrument readings will be obtained upwind of the site work zone in order to determine the level of "background" readings from local vehicle traffic, emissions from nearby operations unrelated to the site, etc. Site readings will be evaluated against these background readings (i.e., if an action level is listed as 20 ppm, it is evaluated as 20 ppm above background).

7.6 DATA LOGGING

All direct-reading instrument monitoring data, including background readings, will be logged in the field log book. The results of daily instrument calibrations can either be logged on the form provided in the Attachments or in the field log book. All monitoring instruments will be calibrated, in accordance

with the manufacturer's instructions or the guidance found in the Attachments, prior to the start of each shift. Calibration should also be performed when inconsistent or erratic readings are obtained. **If an instrument cannot be calibrated to specification, or becomes otherwise inoperable, all invasive site work (i.e., drilling, excavating) will cease until the instrument is appropriately repaired or replaced; the PM or IHT should be contacted for further guidance.**

7.7 REPORTING OF RESULTS

The Contractor's CIH will prepare a letter report for each suite of air samples (one day's sampling effort) within three working days of the date of sampling. The report will reference the information required by Section 7.1.3.1 through 7.1.3.4, and will be submitted to the Project Manager, Contracting Officer, Occupational Physician, and the sampled employees. The CIH will immediately notify the Project Manager or Contracting Officer if sample results indicate benzene exposures above the action level of 0.5 ppm or THC exposures above the 300 ppm TLV for gasoline.

8.0 ENGINEERING AND WORK PRACTICE CONTROLS

Two means of engineering controls have been considered for use on this project: dust reduction, and suppression of hydrocarbon vapors.

8.1 DUST REDUCTION

Dust reduction techniques are designed to reduce the hazards associated with the inhalation of contaminated particulates. Dust reduction will be practiced at the working face of the excavation and on the trucks hauling the excavation spoils.

- A pressurized water hose and spray nozzle will be available at each excavation. If excavation activities create a sustained visible dust cloud, a water spray will be applied to the spoils pile and the working face of the excavation to wet the material only to the point where dust emissions are appropriately reduced to the satisfaction of the IHT.
- Dust emissions from the haul trucks will be reduced by either tarping the load (done by site personnel, as the drivers are to remain in the cab), or by applying a water spray to the load prior to the truck departing the loading area. The IHT will evaluate the effectiveness of the wet method, and require the use of the tarp only if necessary.

Dust is not anticipated to be a hazard during the tilling of the bioremediation pile, as the sprinkler system is designed to keep the pile damp.

8.2 HYDROCARBON VAPOR SUPPRESSION

The use of hydrocarbon vapor suppression techniques is required if OVA readings exceed 750 ppm in the operator's breathing zone, or if detector tubes indicate more than 10 ppm benzene. Previous sampling indicated that benzene concentrations in the soil are less than 1 ppm, and total volatiles as BTEX are less than 50 ppm. If such measurements are truly representative of site conditions, there will be no appreciable vapor hazards. However, if the unexpected occurs, the following vapor suppression techniques can be used:

- The OVA will be used to locate the source of the elevated vapor emission, and plastic sheeting and/or clean soil will be placed over the source. Work can then continue in other areas of the site, and the source area will be checked periodically. Once the vapors at the source have dissipated, work can resume in the source area.

8.3 WORK PRACTICES

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Given the size of the contaminated area, it is not feasible to have personnel work upwind of contaminant source areas. However, the decontamination area and command post will be set up upwind of the exclusion zone if terrain and logistics permit.

Personnel will observe the "buddy system" at all times while in the exclusion zone. No one is to enter the exclusion zone unaccompanied for any reason.

9.0 PERSONNEL TRAINING REQUIREMENTS

All Carswell AFB Project Contractor personnel involved in remedial activities shall satisfy the requirements of 29 CFR 1910.120 (e), including:

- Twenty-four or forty hours (depending upon job assignment) of initial offsite training or its recognized equivalent.
- Eight hours of annual refresher training for all personnel.
- Eight hours of supervisor training for personnel serving as the IHT and PM.
- Three days of work activity under the supervision of a trained and experienced supervisor.

All Carswell AFB Project personnel will participate in a medical surveillance program that meets the requirements of 29 CFR 1910.120(f). The PM or IHT will maintain, at the site, current copies of training certificates and statements of medical program participation for all site personnel.

In addition, all Carswell Site personnel will review this SSHP and sign a copy of the safety plan compliance agreement, which is found in Attachment A. The IHT will maintain these agreements at the site, and forward them to the CIH and PM at the conclusion of the operation.

9.1 INITIAL 24/40-HOUR COURSES

Completion of an approved 40-hour classroom course is required for all Carswell AFB site personnel who will enter an exclusion zone prior to their engaging in any field operations. The course shall cover, as a minimum, the following topics:

- Overview of the applicable paragraphs of 29 CFR 1910.120.
- Overview of RCRA, CERCLA and SARA regulatory requirements.
- Effect of chemical exposures to hazardous substances (that is, toxicity, carcinogens, irritants, sensitizers, and so on).
- Effects of biological exposures.

- Fire and explosion hazards (that is, flammable and combustible liquids, reactive materials).
- General safety hazards, including electrical hazards, powered equipment hazards, walking-working surface hazards, and those hazards associated with hot and cold temperature extremes.
- Confined space, tank, and vault hazards and entry procedures.
- Specific safety, health and other hazards that are to be addressed in the site safety and health plan.
- Use of personal protective equipment and the implementation of the personal protective equipment program.
- Work practices that will minimize employee risk from site hazards.
- Safe use of engineering controls and equipment and any new relevant technology or procedure.
- Content of the medical surveillance program and requirements, including the recognition of signs and symptoms of overexposure to hazardous substances.
- The contents of an effective site safety and health plan.
- Use of monitoring equipment with "hands-on" experience and the implementation of the employee and site monitoring program.
- Implementation and use of the informational program.
- Drum and container handling procedures and the elements of a spill containment program.
- Selection and use of material handling equipment.
- Container sampling procedures and safeguards.
- Safe preparation procedures for shipping and transport of containers.

- Decontamination program and procedures.
- Emergency response plan and procedures.
- Safe site illumination levels.
- Site sanitation procedures and equipment for employee needs.
- Review of the applicable appendices to 29 CFR 1910.120.
- Overview and explanation of OSHA's Hazard Communication Standard.
- Sources of reference, additional information and efficient use of relevant manuals and hazard coding systems.
- Principles of toxicology and biological monitoring.
- Rights and responsibilities of employees and employers under OSHA and CERCLA.
- "Hands-on" field exercises and demonstrations.
- Final examination.

There may be some situations in which personnel engage in specific activities that do not pose a potential for exposures above the PEL. Under the OSHA standard, such personnel need only complete a 24-hour training course. Should it be feasible to have selected personnel engage in such limited activities, the above training protocol will be altered to meet the 24-hour course criteria as outlined in the proposed 29 CFR 1910.121; such training excludes respiratory protection training and most field exercises. However, due to the limitations placed on personnel with 24-hour training, it is not anticipated that such a training program will be implemented.

9.2 REFRESHER COURSES

All onsite personnel shall complete an 8-hour refresher course annually in order to maintain their eligibility for protection in hazardous waste field operations.

This course shall cover, as a minimum, the following topics:

- Regulatory Update
- Medical Surveillance Program
- Occupational Exposure Limits
- Personal Protective Equipment
- Respiratory Protection
- Monitoring Instruments
- Heat and Cold Stress
- Safe Work Practices
- Trenching and Excavations
- Confined Space Recognition
- Site Safety Plans
- Health and Safety documentation

9.3 SUPERVISOR TRAINING

All on-site supervisors are to complete an eight-hour supervisor course that meets the requirements of 29 CFR 1910.120. The course is to cover, as a minimum, the following topics:

- The Contractors Site Health and Safety Program
- Personal Protective Equipment Program (Level B, C and D)
- Emergency Response Plan
- Health hazard monitoring procedure and techniques
- Spill containment program
- Hazard Communication Program

9.4 SITE SAFETY BRIEFINGS

Prior to the start of operations at the site, and for all new personnel, the IHT will conduct a site safety briefing, which will include all personnel involved in site operations. At this meeting, the IHT will discuss:

- Contents of this SSHP;
- Personnel rights and responsibilities under OSHA;
- Names of employees and alternates responsible for safety and health;

- Types of hazards at the site and means for minimizing exposure to them;
- Health effects associated with exposure to petroleum hydrocarbon products;
- The type of monitoring that will be performed;
- Action levels for upgrade and downgrade of personal protective equipment;
- Personal protective equipment that will be used;
- Heat stress and cold stress monitoring and control;
- Engineering controls;
- Decontamination protocol;
- Site control measures, including safe operating practices and communication;
- Location and use of emergency equipment;
- Evacuation signals and procedures;
- Routes of entry, toxicology, and health hazard information; and
- Conduct hazard communication training for all chemicals brought onsite. MSDS's for the chemicals brought onsite are located in Attachment J.

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Subsequent site safety briefings will be conducted at least weekly to discuss problems observed during the previous week such as improper use of respirators or protective clothing, violation of decontamination procedures, and other variances from the SSHP. The briefing will also discuss the hazards associated with additional chemicals brought onsite by contractor personnel. The IHT will also provide special training when unanticipated problems or changes in cleanup operations occur and to new employees as needed.

For each briefing, the IHT will complete a Site Safety Briefing form (see Attachment F) and submit each on a regular basis to the PM and CIH.

9.5 FIRST AID/CPR TRAINING

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The IHT and each subcontractor safety representative shall maintain current certification in American Red Cross First Aid and CPR training or the equivalent. It is recommended that at least one person with current First Aid/CPR certification be present in each major work area. All other onsite personnel who are responsible for responding to site emergencies and incidents shall maintain current certification in American Red Cross First Aid and CPR training or the equivalent.

9.6 VISITOR TRAINING

The IHT will train visitors to aid in protecting their safety while visiting the site. The training will familiarize visitors with hazards associated with the site, describe work zone boundaries and access and exit procedures, explain emergency procedures, and describe the use of PPE required during the visit. The Contractor will also provide respirator fit testing and training to authorized USAGE personnel and visitors.

All USACE personnel and visitors are required to provide proof of medical fitness or clearance to the IHT prior to being fit tested, provided with a respirator or provided with protective equipment capable of causing heat stress. Visitors are not required to have the 40 hours of training given to site employees unless they intend to enter the CRZ or EZ.

10.0 SITE CONTROL

10.1 GENERAL

Barricades and barricade tape will be used to delineate an exclusion zone around the work area as described in Section 10.3. A short piece of barricade tape will be affixed to a secure upright to serve as a wind-direction tell-tale. A five foot opening in the barricades at the support zone (upwind of the work area) will serve as the personnel and equipment entry and exit point. The personnel decontamination station will be established at this point. All entry to and exit from the work area will be made at this opening in order to control potential sources of contamination (i.e., leave contaminated soil and debris in the exclusion area).

The PM or IHT will designate an upwind evacuation area prior to each shift; this area should be out of the path of vehicular traffic. All personnel should be notified of its location. A compressed gas horn or two way radios will be used to signal an evacuation in the event of an emergency. Three blasts of the horn could be the agreed-upon signal to immediately stop work and proceed to the evacuation area.

The IHT will maintain a list of all authorized personnel on the site, and will see that all site visitors sign the visitors' log and that all site personnel who enter the work zone do so only after presenting evidence of both their participation in a medical surveillance program, completion of health and safety training programs that fulfill the requirements of this plan, and are wearing the appropriate PPE for that work zone. The IHT will provide site hazard and emergency action information to all site visitors before they enter the site; this can be done by providing a copy of this SSHP to the visitor.

It is the Contractor's understanding that the flightline located adjacent to the flightline ditch work area is currently closed, thus USACE additional health and safety requirements for work conducted inside the flightline area will not be implemented.

10.2 WORK ZONES

The following work zones will be set up in the following manner to help control the spread of hazardous materials out of the immediate work area.

- Exclusion Zone - a perimeter around the work area will be defined and delineated before work starts. The encircled area will constitute the "Exclusion Zone" (EZ). This zone is where potentially hazardous contaminants and physical hazards to the workers will be contained. Full personal protection will be required in this area. The size of the Exclusion Zone may be altered to accommodate site conditions and to enhance contaminant containment.

During excavation operations, the excavation itself will be marked with a prominent visible barrier to warn site personnel and visitors of a potentially dangerous area. These visible barriers will remain in place until the excavation is backfilled to its original elevation.

- **Truck-loading Zone (TLZ)** - the truck loading zone encompasses the area where the trucks are loaded with contaminated soil. Only those trucks that are being loaded are allowed to be inside the truck loading zone. Truck drivers are required to stay inside their trucks with all the windows and vents completely closed.

The truck loading zone will be located in the Contamination Reduction Zone. Contaminated soil will be loaded into the truck utilizing a loader/excavator located in the exclusion zone. The truck loading area will be covered with 20 mil visqueen. As the excavation area moves, the truck loading zone, along with the 20 mil visqueen tarp, will move to stay directly adjacent to the exclusion zone and the work area. Trucks will be decontaminated prior to leaving the TLZ as described in Section 13.2.1.

- **Contamination Reduction Zone (CRZ)** - a corridor leading from the Exclusion Zone will be defined, and will lead from the work area to a break area. All decontamination activities will occur in the CRZ. A waste container will be placed at the end of the corridor so contaminated disposable equipment can be placed inside and covered. Surface/soil contamination in this area should be controlled using plastic sheeting. Change and shower rooms will be located at the perimeter of the CRZ.
- **Support Zone** - a Support Zone, the outermost part of the site, must be defined for each field activity. Support equipment is located in this uncontaminated or clean area. Normal work clothes are appropriate within this zone. The location of this zone depends on factors such as accessibility, wind direction (upwind of work area), and resources (that is, roads, shelter, utilities). Toilets, break areas, lunch areas and general support areas will be located in this zone.

If feasible, access gates to the work areas will be closed and locked from the end of each shift until work commences the following morning.

10.3 CAUTION SIGNS AND LABELS

Before site operations commence, the perimeter of the work area will be marked with steel posts connected with colored "Caution" tape, and triangular warning flags or signs will be posted every 100 linear feet around the perimeter and at the entrance that read:

HAZARDOUS AREA - KEEP OUT

This sign will also direct visitors to the visitor entrance.

Before soil removal operations commence, the perimeter of the soil removal area will be marked with steel posts connected with colored "Caution" tape, and triangular warning flags or signs will be posted every 100 linear feet around the perimeter and at the entrance that read:

HAZARDOUS AREA - KEEP OUT

DANGER

AUTHORIZED PERSONNEL ONLY

PERSONAL PROTECTIVE EQUIPMENT IS REQUIRED IN THIS AREA

The same signage and posting requirements will be utilized in the biotreatment area.

In addition, a sign will be posted in the CRZ, TLZ, and EZ that reads "NO SMOKING". Designated smoking areas (i.e. break areas and lunch areas) will be posted with a sign that reads "Smoking is Permitted in this Area".

All signs and labels will be printed in bold large letters on contrasting backgrounds. Signs will be placed in an area where they are visible from all points where entry might occur and at such distance from the restricted area that employees may read the signs and take necessary protective steps before entering.

10.4 VISITOR CONTROL

All site visitors (including Federal and state agency employees, etc.) will be required to obtain a visitor badge from the IHT and sign a visitor log prior to entering the site. The IHT will inform the visitors of the site hazards, site rules, emergency procedures, and personal protective equipment requirements before they enter the site. At no time will visitors be allowed to enter the exclusion zone unless they show proof of training in accordance with 29 CFR 1910.120 (e), and are enrolled in a medical surveillance program which meets the requirements of 29 CFR 1910.120 (f).

11.0 MEDICAL SURVEILLANCE PROGRAM

This section describes the minimum medical screening requirements that will be used to provide a method of identifying those employees whose medical history indicates potentially increased health risk when exposed to the added burden associated with protective equipment and/or toxic chemicals present at the Carswell AFB Site. This section also describes the minimum medical screening which will be used to determine if personnel can use positive and negative pressure respirators and to document exposure to specific contaminants.

11.1 SCHEDULING OF EXAMINATIONS

All project personnel performing work in potentially contaminated areas, regardless of length of employment at the site, are required to participate in the medical surveillance program. The following medical surveillance intervals will be provided for all Contractor employees working inside of the exclusion zone:

- Prior to the start of work, all personnel must undergo a baseline medical examination. The results of the examination must be reviewed and approved by the occupational physician prior to being permitted access to the contaminated or potentially contaminated areas of the site.
- All personnel included in the program must obtain at least one medical examination per year during the term of site activity.
- If an employee develops signs or symptoms of illness related to potential workplace exposures, then the occupational physician will be contacted and a medical exam will be performed.
- All employment terminations will be reported to the IHT and the occupational physician, and a termination exam must be completed.
- When an employee develops a lost time injury or illness during the period of this contract.

When an employee develops a lost time injury or illness during the project, the Occupational Physician will provide the employee's supervisor with a written statement allowing the employee to return to the work site after the illness. This written statement must be signed by the Occupational Physician and a copy must be submitted to the Contracting Officer as part of the weekly safety report (See Section 14.11.2).

These are the minimum medical surveillance intervals for all employees working on the Carswell AFB Remediation Project. The Certified Occupational Physician will review all medical exams submitted by the Contractor's Physician and will issue a Physician's Opinion Report.

Prior to participating in the medical surveillance program, each contractor will provide the following information to the examining physician:

- Information on the employee's anticipated or measured exposure;
- PPE use;
- A description of the employee's duties;
- A copy of 29 CFR 1910.120; and
- Information from previous examinations not readily available to the examining physician.

11.2 ADMINISTRATION AND RECORDKEEPING

After completion of the medical evaluations, the Contractor's Physician will send copies of all results to the Dames & Moore Occupational Physician at the following address:

Dr. Gary Krieger
c/o Dames & Moore
1125 Seventeenth Street, Suite 1200
Denver, Colorado 80202-2027
(303) 294-9100

The Dames & Moore Occupational Physician will then issue a Summary Profile (a written physicians opinion) which will contain the following information:

- The physician's recommended limitations upon the employee's assigned work;
- The physician's opinion which indicates the presence or absence of work restrictions for each employee; and
- A statement that the employee has been informed of the hazards and advised about the results of the examination.

The contractor will furnish certification of employee's physician fitness to the Contracting Officer and to the IHT before work begins. The IHT will keep a copy of this Summary Profile in each employee's training/medical monitoring files, for the duration of the project.

If there are any anomalies in the exam results, the occupational physician will contact the employee directly. Medical examinations instituted as part of this health and safety plan should not be considered substitutes for regular checkups that are designed to monitor general health. Medical examinations associated with this project are designed to screen for evidence of potential adverse effects due to exposure to toxic substances and physical agents.

11.3 RECORDKEEPING

All medical and exposure records must be retained by the Occupational Physician for a period of at least 30 years beyond an employee's last day of employment. These records are accessible only by the participants and the consulting physician. Pertinent medical information may be shared with emergency medical facilities adjacent to hazardous work sites.

As required by OSHA standards, records of employee medical history must be made available on request to the employees, employee representatives, and OSHA. The standard applies to all employers in general industry, construction and maritime operations whose employees are exposed to toxic substances and harmful physical agents. By providing workers with information they can use to detect, treat, and prevent occupational diseases, the policy is intended to increase awareness of workplace hazards and allow workers to play a meaningful role in their own health management.

11.4 EXAM PROTOCOLS

- Based on ongoing job history, exposure data and age, the Occupational Physician will determine testing needed per employee.
- Annual and special exam packets and instructions will be sent as they are due from the Occupational Physician to the IHT or SSR for distribution to the employee 1 month prior to the due date.
- Each employee must complete the entire exam packet prior to the exam appointment and should follow the exam packet instructions completely.
- Physicians selected will complete the exam and forward all results to the Occupational Physician.

- Upon receipt of the complete exam results, the Occupational Physician will review the information and will write a summary profile, which describes presence or absence of work restrictions. A sample summary profile is on the following page. The original summary profile will be kept with the medical records.
- A preliminary evaluation from the physician who conducted the exam should be available within 3 days of the exam.
- The employee will be referred to their personal physician for medical problems discovered during the exam. Pertinent medical information will be sent to the employee, which will be documented in the medical record.
- The employee must assure that a copy of the follow-up report by their private physician is sent to the Occupational Physician.

11.5 SPECIFIC COMPONENTS OF EXAMS

Baseline

The baseline medical exam will consist of the following:

- A medical and occupational history questionnaire with emphasis on the following systems: nervous, skin, lung, blood forming, cardiovascular, gastrointestinal, reproductive, as well as ears, nose, and throat.
- A complete physical exam, including at least the following:
 1. Height, weight, temperature, pulse, respiration, and blood pressure
 2. Head, nose, and throat
 3. Eyes (Snellen)
 4. Ears (audiometric testing at 500, 1,000, 2,000, 3,000, 4,000, 6,000, and 8,000 Hz including an otoscopic examination of the ear for wax, and questionnaire)
 5. Chest (heart and lungs)
 6. Peripheral vascular system
 7. Abdomen (liver, spleen, and kidney)
 8. Musculoskeletal system
 9. Genitourinary system
 10. Skin
 11. Nervous system

12. Pelvic, breast, and rectal (Guaiac) examination for women
13. Testicular and rectal (Guaiac) examination for men

- Tests

1. Complete blood counts and chemistries (CBC) including:
 - a. White blood cell differential cell and platelet counts
 - b. Hemoglobin and/or hematocrit
 - c. Albumin, globulin, total protein and total bilirubin
 - d. Serum glutamic oxalacetic transminases (SGOT) and SGPT
 - e. Lactic dehydrogenase (LDH)
 - f. Alkaline phosphate and Gamma Glutamine Trans Peptidase (GGTP)
 - g. Calcium
 - h. Phosphorous
 - i. Uric acid
 - j. Creatinine
 - k. Urea nitrogen
 - l. Cholesterol and triglycerides
 - m. Glucose
 - n. RBC Cholinesterase
2. Urinalysis (Clean Catch), including:
 - a. Color and character
 - b. Specific gravity
 - c. pH
 - d. Protein
 - e. Acetone
 - f. Glucose
 - g. Microscopic examination
3. PA Chest-X-ray (14 x 17 inch P-A performed for the baseline exam)
4. Pulmonary function test to include, at a minimum:
 - a. Forced vital capacity (FVC)
 - b. Forced expiratory volume, one second (FEV₁)
 - c. The FEV₁:FEC ratio

5. Standard 12-lead resting electrocardiogram (EKG).

Annual Medical Exam

The annual medical exam is similar to the baseline, with the following exceptions:

- An annual questionnaire is administered in place of the Comprehensive Medical History Questionnaire.
- Chest x-rays are not performed annually, but less frequently, depending upon age and regulatory requirements (for example, for asbestos).
- The EKG will be performed every 3 years for those under the age of 40, every 2 years for those aged 40 to 50, and annually for those over 50 years of age.

Termination Exams

The termination exam is conducted at the discretion of the Occupational Physician on the basis of an individual's medical and exposure history. All project personnel who worked in the exclusion zone or who may have otherwise be exposed to elevated levels of site contaminants will have a termination exam. The employee's supervisor should contact the Occupational Physician upon notification of termination to determine whether an exit exam is needed.

Baseline Labwork For Hazardous Materials Exams

- Urinalysis (microscopic)
- Complete Blood Count (with differential)
- RBC Cholinesterase (not always necessary; only needed if pesticide work is anticipated)
- 24 Item Blood Chemistry Panel

Calcium	Cholesterol
Phosphorus	Triglycerides
Sodium	T. Protein
Potassium	Globulin
Chloride	Albumin
LDH	A/G Ratio
AST (SGOT)	BUN
T. Bili	Creatinine
GGT	Uric Acid

ALT (SGPT)	Glucose
Alk. Phos.	Iron
HDL	T ₄

Special Tests (as required)

- Chest x-ray (14- x 17-inch P-A)
- EKG Stress Test
- RBC Cholinesterase
- Blood Lead
- Zinc Protoporphyrin
- PCB
- Arsenic, Cadmium, and Mercury; other heavy metals
- Thiocyanate
- Uroporphyrin
- Hexachlorobenzene
- Methemoglobin

12.1 PERSONNEL DECONTAMINATION

12.1.1 Contamination Prevention

- Eating, drinking, smoking, application of cosmetics, and chewing tobacco are prohibited in the work area. These activities are permitted in the support zone only after the employees have removed their protective clothing and respirators and washed their hands and face.
- Disposable clothing, gloves, hard hats and respirators will be removed before leaving the work area. Hard hats used in the exclusion cannot be taken out of the exclusion zone until they have been completely decontaminated.
- Employees will not kneel or sit on the ground or on drums, containers or other contaminated areas.
- As practical, monitoring and sampling instruments will be covered with visqueen or placed in a plastic bag prior to entrance into the exclusion zone to protect them from becoming contaminated.
- Good housekeeping is of primary importance for an effective decontamination program and is enforced accordingly. Discarded equipment will be disposed of in appropriate containers (that is, gloves, rags, coveralls, and so on.).
- Employees will not remove any contaminated clothing or equipment from the site.
- Torn or otherwise damaged protective clothing, gloves, rubber boots, safety glasses and hard hats will be replaced immediately.

12.1.2 Decontamination Area

- The decontamination area is to be covered with plastic sheeting which should be replaced when torn or heavily soiled, and at the end of each shift. A schematic of a recommended "Minimum Layout of Personnel Decontamination Station" is provided in Attachment D. The IHT will evaluate actual site conditions and needs of the workforce when setting up the decontamination area.

- All spent decontamination fluids (rinse waters, and so on) will be handled as hazardous waste until lab results indicate otherwise. Fluids will be placed in proper containers, such as 55 gallon, metal, DOT approved drums, and handled and labelled in accordance with OSHA (or State equivalent), EPA, DOT, and other relevant regulations.
- Disposable clothing, gloves and spent respirator cartridges will be disposed of after each work shift. These items are to be placed in waste receptacles located inside the CRZ. These waste receptacles are to be emptied daily into hazardous waste containers for shipment to an approved disposal facility.
- Employees will use a clean respirator and fresh cartridges on each work shift. Employees will be responsible for the cleaning and maintenance of their respirators. Used respirators are to be cleaned by the employee at the end of each shift. Clean respirators are stored in respirator bags.

12.1.3 Decontamination Procedures for Level D and Level C Protection

- Remove all monitoring equipment, sample containers, and notes to the CRZ. The decontamination helper will obtain decontamination solutions and decon the equipment as necessary.
- Scrub boots and gloves with a stiff bristle brush and decontamination solution. Rinse with water. Washtubs and chairs will be provided.
- Remove tape from around wrist and ankles.
- Remove outer gloves.
- Wash gross contamination from disposable Saranex coverall.
- Remove chemical protective boot.
- Remove disposable Saranex coverall taking care not to touch the outside of the garment; discard in provided container.
- Remove hardhat and eye protection (place in bin to be decontaminated).
- Remove respirator (Level C protection only).

- Remove inner gloves; discard in provided container.
- Wash hands and face in soapy water and rinse with potable water.

12.1.4 Procedures for Direct Contact with Hazardous Waste

- Any protective clothing or respirators that become impacted with liquid or sludge waste materials will be replaced immediately. The impacted items will be discarded in an appropriate waste receptacle.
- Any employee whose skin, eyes, and so on, becomes impacted with hazardous materials will use the emergency safety showers and/or eyewash provided at the site to rinse off the contamination. Following this, the employee will remove his/her protective clothing and respirator and dispose of them in the appropriate laundry or waste receptacle for cleaning or disposal. The employee will then proceed to the CRZ, go through decontamination, and don a clean uniform. If warranted, the employee shall be taken for immediate medical attention. ALL such incidents must be reported to the SSO or the PM immediately after decontamination.

12.1.5 Personnel Decontamination in Medical Emergencies

- In the event of physical injury or other serious medical concerns, immediate first aid should be administered in lieu of further decontamination efforts.
- See "Emergency Decontamination Chart," at the end of this section, for a decision tree for emergency decontamination.

12.2 EQUIPMENT DECONTAMINATION

12.2.1 Decontamination of Onsite Haul Vehicles

Trucks that are used to transport contaminated material from the excavation to the bioremediation cell will be subject to the following practices to minimize the transfer of contamination.

- All trucks will be loaded in the TLZ as described in Section 10.2.

- Truck beds will be lined with 6 mil polyethylene sheeting (visqueen) prior to loading to minimize bed contamination.
- After loading, the truck will pull forward out of the active loading area (remaining in the TLZ), and the loader helper, dressed in Level C protection, will sweep spilled soil from outside surface of the truck and trailer, including the tires. Once this is completed, and the load is either wetted or tarped (as described in Section 8.1.1), the truck can proceed to the bio cell.
- The truck cleaning area described above will be swept down between trucks to prevent the trucks from picking up contaminated material on tire surfaces.

12.2.2 Heavy Equipment Or Site Vehicle Removal for Repair Or Servicing

- All heavy equipment or other site vehicles (that is, pickup trucks) which have likely contacted contaminated materials will be thoroughly decontaminated by washing them with decontamination solution (that is, TSP solution or other dilute alkali detergent solution) or steam cleaning at the appropriate decontamination pad, before they are repaired or serviced.
- All spent decontamination fluids or sludges (that is, rinse waters, mud slurries, and so on) will be handled as hazardous waste until lab results indicate otherwise. Fluids and sludges will be placed in proper containers (that is, 55 gallon drums, tanks, bins, and so on) and handled and labelled in accordance with OSHA (or State equivalent), EPA, DOT, and other applicable regulations.
- Spent air filters will be considered as potentially contaminated and disposed of in the proper manner.

12.2.3 Vehicle Or Heavy Equipment Decontamination To Leave Site

Prior to heavy equipment leaving the exclusion zone, or any vehicles that have been in the EZ, TLZ, or CRZ leaving the active project area (i.e., leaving the base), the following steps must be taken.

- Where it is likely that vehicles or heavy equipment has come in contact with contaminated material, such equipment will be decontaminated upon leaving the exclusion zone. As much mud, dirt, rocks, and so on, as possible will be

mechanically removed from the tires, tracks, or outside of the equipment, prior to leaving the EZ.

- After gross contamination is removed in the EZ the equipment may be driven onto a decontamination pad located adjacent to the exclusion zone in the contamination reduction zone. The pad should be constructed in a manner that will permit all wash and rinse fluids to be contained and collected and the pad to be readily washed down to prevent a buildup of contamination; heavy gauge plastic sheeting and sandbags or a concrete pad can be used for this purpose, and a suction device used to collect liquids. A high pressure, high temperature steam cleaner may be used to wash down heavy equipment.
- All spent decontamination fluids or sludges (that is, rinse waters, mud slurries, and so on) will be handled as hazardous waste until lab results indicate otherwise. Fluids and sludges will be placed in proper containers (that is, 55 gallon drums, tanks, bins, and so on) and handled and labelled in accordance with OSHA (or State equivalent), EPA, DOT, and other relevant regulations.
- Air filters shall be replaced prior to the equipment leaving the site. Spent air filters will be considered potentially contaminated and disposed of in the proper manner.
- Interiors of the vehicles and equipment will be thoroughly wet-wipe cleaned prior to leaving the site. Cleaning rags will be considered as potentially contaminated and disposed of in the proper manner.
- Following the washing, the equipment will be inspected by the IHT or CIH. Upon SSO approval, the equipment may leave the active project area. Under no circumstances will heavy equipment be allowed to leave the site if it is not decontaminated.

12.2.4 Decontamination of Tools

- When all work activities have been completed, contaminated tools shall be totally decontaminated. A job is NOT considered complete until the work area has been cleaned and all used material properly discarded and tools cleaned and properly stowed.

- It is expected that all tools will be constructed of non-porous, non-absorbent materials. This will aid the decontamination process. Any tool, or part of a tool, which is made of a porous/absorbent material (that is, wood or cloth) should be discarded and disposed of as a hazardous waste if it cannot be properly decontaminated.
- Tools will be placed on a decontamination pad or into a bucket and thoroughly washed using a soap solution and brushing or high pressure spray, followed by a water rinse. All visible particles should be removed before the tool is considered clean. If contaminants are not easily cleaned with water due to organic nature, an organic solvent may be used at the direction of the IHT or CIH.

12.2.5 Decontamination of Monitoring Equipment

Due to the sensitive electronic nature of industrial hygiene monitoring equipment, special care shall be taken when decontaminating it. If the equipment is likely to contact contaminated materials during its use in the EZ, it shall be wrapped in plastic to protect it in a manner that does not interfere with its function or use; do not tightly wrap equipment, such as sampling pumps, that require an exhaust outlet. A damp wipe down with a cloth moistened with decontamination solution shall be conducted before leaving the EZ if the equipment contacted contaminated materials during use.

13.0 EMERGENCY RESPONSE PLAN

13.1 PLAN PROCEDURES

13.1.1 Purpose

The purpose of this emergency response plan is to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil or surface water.

The provisions of this emergency response plan must be implemented immediately whenever there is a fire, explosion, or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment.

13.2 RESPONSIBILITIES AND ORGANIZATION

13.2.1 Emergency Coordinator (EC)

The IHT will act as the EC at the Carswell AFB project site. The EC has the responsibility for coordinating all emergency response measures, and initiating materials and equipment purchases. Qualified backup ECs will be designated to ensure that an EC will either be located on the site or on call (available to reach the site to respond to an emergency in a short period of time). The EC has the authority to commit the resources required to implement this emergency response procedure.

The EC is responsible for being thoroughly familiar with:

- The SSHP and emergency response plan.
- All operations and activities associated with the project.
- The location and characteristics of the waste handled.
- The emergency signals and evacuation routes.
- The location of all operation-specific records.
- The physical layout of the facility and location of emergency equipment.

13.3 COORDINATED EMERGENCY SERVICES

13.3.1 Obtaining Emergency Services

To obtain emergency services, the Emergency Coordinator will first investigate the severity of the emergency/injury. If the emergency/injury requires outside emergency services, the EC will immediately contact the appropriate emergency services. The USACE Contracting Officer will be notified next of the emergency and the impending arrival of emergency services. The Contracting Officer and subcontractor safety representatives will at this time be informed of any possibility of the need for an evacuation, if the circumstances indicate.

13.3.2 Communications

A communication network will be set up to alert site personnel of emergencies and to summon outside emergency assistance. Where voice communication is not feasible an alarm system (i.e., sirens, horns, etc.) will be set up to alert employees of emergencies. Radio communication may also be used to communicate with personnel in the exclusion zone. Where phone service is not readily available, radios or portable phones will be used to communicate with outside agencies. Site personnel will be trained on the use of the site emergency communication network. Emergency phone numbers will be posted at the phone or radio used for outside communication. The IHT/EC is responsible for establishing the communication network prior to the start of work, and for explaining it to all site personnel during the site safety briefing.

The following hand signals will be used by personnel in the event of an emergency:

<u>Signal</u>	<u>Definition</u>
Hands clutching throat	Out of air/can't breathe
Hands on top of head	Need assistance
Thumbs up	OK/I'm alright/I understand
Thumbs down	No/negative
Arms waving upright	Send back support
Grip partner's wrist	Exit area immediately

13.3.3 Emergency Services Information

In the event of an emergency, site personnel will evacuate from areas involved in hazardous material emergencies and summon outside assistance from agencies with personnel trained to deal with the specific emergency. This section outlines the procedures to be followed by site personnel in the event of a site emergency. These procedures are to be reviewed during the onsite safety briefings conducted by the IHT/EC.

In the event of a fire or medical emergency, the following numbers can be called for assistance:

Fire: 911
Ambulance: 911
Hospital: R.L Thorton (Carswell) Strategic Hospital (response time within 3 minutes)
(817) 782-4000

All Saints Episcopal Hospital (response time within 10 minutes)
(817) 926-2544

Police: 911

DIRECTIONS TO R.L. THORTON STRATEGIC HOSPITAL

From the Flightline Ditch Area - travel east on White Settlement Road to Alta Mere Drive and turn left (east). Proceed east on Alta Mere Drive to Pumphrey Drive and turn left (north). Proceed north on Pumphrey Drive to Carswell Access and turn right (east). From Carswell Access turn left (northwest) on Meandering and follow to the hospital.

From the Fire Training Area - proceed north on Knights Lake to Carswell Access and turn right (east). Proceed east on Carswell Access to Meandering and turn left. Follow Meandering to the hospital.

DIRECTIONS TO ALL SAINTS EPISCOPAL HOSPITAL

From the Flightline Ditch Area - travel east on White Settlement Road to Alta Mere Drive and turn right (southwest). Proceed southwest on Alta Mere Drive to West Freeway 30 and go east. Exit Freeway 30 at Rosedale Street going east. Proceed east on Rosedale Street to 8th Avenue and turn right (south). This hospital is located on the south west corner of Harrison and 8th Avenue.

From the Fire Training Area - proceed north on Knights Lake to Carswell Access and turn right (east). Proceed east on Carswell Access to Pumphrey Drive and turn right (south). From Pumphrey Drive turn right (southwest) on Alta Mere Drive and proceed southwest on Alta Mere Drive to West Freeway 30 and go east. Exit Freeway 30 at Rosedale Street going east. Proceed east on Rosedale Street to 8th Avenue and turn right (south). The hospital is located on the south west corner of Harrison and 8th Avenue.

Prior to the commencement of site cleanup operations, the IHT/EC will notify emergency medical personnel, ambulance crews, and hospital emergency room staff of the possibility of having to handle contaminated clothing or employees, or both, and will advise them of appropriate decontamination measures. Copies of this SSHP will be provided to emergency units as appropriate prior to the start of work.

13.4 EMERGENCY PROCEDURES

This section of the emergency response plan describes the actions that will be taken by Contractor personnel in response to any injury, accident, fire, explosion, or unplanned sudden or non-sudden release of hazardous waste, hazardous waste constituent, or hazardous material to the air, soil, or surface water.

Upon discovery or notification that an emergency exists, the EC shall:

- Determine the extent of the emergency.
- Implement plant evacuation, if needed, to prevent injury.
- Call for outside assistance as needed.
- Notify the USACE Contracting Officer.
- Start immediate control actions.
- Implement cleanup or other responses.
- Notify local, state, and Federal agencies as required.
- Assure completion of cleanup.
- Provide for storage of cleanup material, including hazardous waste.
- Evaluate possible hazards to human health or environment.
- Make a final written incident report.

Whenever there is an imminent or actual emergency situation, the emergency coordinator, or his designee, will:

- Immediately call by radio or phone to notify all site personnel, and sound the audible alert system (i.e., siren, alarm).

- Immediately notify the appropriate Federal, state, and/or local agencies with designated response roles if their help is needed.

13.5 ESCAPE ROUTE AND PLACES OF REFUGE

In the event of a site emergency requiring evacuation, all personnel will evacuate to a pre-designated area located a safe distance from any health or safety hazard and safely away from the area of influence. The IHT/EC will designate escape routes and a primary assembly area prior to the start of work each day. The daily pre-designated assembly area may have to be re-designated by the IHT/EC in the event of an emergency where the area of influence affects the primary assembly area. Once assembled, the IHT/EC shall take a head count. The IHT/EC will evaluate the assembly area to determine if the area is outside the influence of the situation; if not, the IHT/EC will redirect the group to a new assembly area where a new head count will be taken.

During any site evacuation, all employees shall be instructed to observe wind direction indicators. During evacuation, employees will be instructed to travel upwind or crosswind of the area of influence. The IHT/EC will provide specific evacuation instructions, via the site emergency radio if necessary, to site personnel regarding the actual site conditions.

13.6 FIRE PROTECTION

Type ABC fire extinguishers will be available onsite to contain and extinguish small fires. The local fire department shall be summoned (911) in the event of any fire on site. The nearest fire station should be notified of operations prior to their commencement, and will be provided with a copy of this SSHP.

13.7 EMERGENCY MEDICAL TREATMENT AND FIRST AID

The IHT and at least one subcontractor safety representative for each work area will hold a current certificate in American Red Cross Standard First Aid. This training provides four hours of Adult CPR and four hours of Basic First Aid. If a medical emergency exists consult the emergency phone number list located in Section 13.3.3 and request an ambulance immediately. Perform First Aid/CPR as necessary, stabilize the injured, decontaminate if necessary, and extricate only if the environment they are in is dangerous or unsafe and ONLY if the rescuers are appropriately protected for potential hazards they may encounter during the rescue. When emergency services personnel arrive, communicate all first aid activities that have occurred. Transfer responsibility for care of the injured/ill to the emergency services personnel.

The following items and emergency response equipment will be located within easy access at all times:

- First Aid Kit (see recommended contents - Section 13.7.1) and stretcher;
- American Red Cross Standard First Aid Manual;
- Eyewash - A 15 minute eyewash or an appropriate amount of portable sterile eyewash bottles will be available on site for flushing foreign particles or contaminants out of eyes. The IHT will demonstrate the proper operation of the unit(s) prior to the start of work;
- Emergency Phone Numbers List;
- Portable radios for emergency communications in remote areas;
- Portable fire extinguishers; and
- Copies of the posters on CPR, choking, rescue breathing.

13.7.1 First Aid Supply List (as approved by the Occupational Physician)

Adhesive dressings
 Adhesive tape rolls, 1 inch wide
 Sterile eye dressing packets
 1 inch gauze bandage rolls
 2 inch gauze bandage rolls
 4 inch gauze bandage rolls
 Sterile gauze pads, 2 inch square
 Sterile gauze pads, 4 inch square
 Sterile surgical pads suitable for pressure dressings
 Triangular bandages
 Safety pins
 Tweezers and scissors
 Tape for bandaging
 Ace bandages
 Latex gloves
 Sterile gloves
 Pen light
 Hydrogen peroxide
 Sterile eye irrigating solution
 Ammonia inhalants
 Glucose packets (for diabetics)
 Splints (arm and leg)

Antibiotic ointment
Cotton-tipped applicators
Flashlight
Cold packs
Blankets (2)
CPR Microshields/Clear Mouth Barriers (2)

Drugs, inhalants, or medications shall not be included in the First Aid Kit.

Supplies should be re-ordered as they are used. A monthly inventory must be done on the first aid kit contents and supplies re-ordered that have been used and not reported.

13.7.2 First Aid for Poisonous Bites and Stings

Rattlesnakes may be encountered at the site. The following information is presented to assist site personnel in controlling and treating snakebites. Additional information may be sought from the Certified Occupational Physician.

13.7.2.1 Snakebites

Reactions from snakebite are aggravated by acute fear and anxiety. Other factors that affect the severity of local and general reaction from poisonous snakebite include: the amount of venom injected and the speed of absorption of venom into the victim's circulation; the size of the victim; protection from clothing, including shoes and gloves; quick antivenom therapy; and location of the bite.

First Aid Procedure: The objective of first aid is to reduce the circulation of blood through the bite area, to delay absorption of venom, to prevent aggravation of the local wound, and to sustain respiration.

The most important step is to get the snakebite victim to the hospital quickly. Meanwhile, take the following first aid measures:

1. Keep the victim from moving around.
2. Keep the victim as calm as possible and preferably in a lying position.
3. Immobilize the bitten extremity and keep it at or below heart level.

4. Get the victim to a hospital immediately.

Several other factors must be considered in cases of snakebite:

- Shock: Keep the victim lying down and comfortable, and maintain his or her body temperature.
- Breathing and heartbeat: If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform cardiopulmonary resuscitation (CPR) if you have been trained to do so.
- Identifying the snake: If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.
- Cleaning the bitten area: You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages, but only for a short period of time.
- Medicine to relieve pain: Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Some painkillers, however, may be given. Consult a doctor or other medical personnel for specific medications that may be used.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of snakebite.

13.7.2.2 Insect bites and stings

Reactions from insect bites and stings are usually not a life threatening issue unless individuals are allergic to the venom introduced into the circulatory system. If individuals are allergic to bee stings or insect bites, the following first aid procedures should be followed before emergency services arrive.

First Aid Procedure: The objective of first aid is to reduce the circulation of blood through the bite area, to delay absorption of venom, to prevent aggravation of the local wound, and to sustain respiration.

The most important step is to get the bite victim to the hospital quickly. Meanwhile, take the following first aid measures:

1. Keep the victim from moving around.
2. Keep the victim as calm as possible and preferably in a lying position.
3. If the victim has been prescribed a Bee Sting Kit or Anaphylaxis Emergency Treatment Kit for insect bites, quickly administer the antidote injection. The antidote shot is an intramuscular or subcutaneous injection only. Do not inject directly into a vein or artery.
4. Immobilize the bitten extremity and keep it at or below heart level.
5. Get the victim to a hospital immediately.

Several other factors must be considered in cases of allergic insect bites:

- Shock: Keep the victim lying down and comfortable, and maintain his or her body temperature.
- Breathing and heartbeat: If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform cardiopulmonary resuscitation (CPR) if you have been trained to do so.
- Identifying the insect: If you can, capture the insect and bring it to the hospital for identification.
- Cleaning the bitten area: If the stinger is still present, it should be carefully pulled out and the area washed with soap and water. You may apply dressings and bandages, but only for a short period of time.

13.8 OPERATIONS SHUTDOWN

Under certain extreme hazardous situations the IHT or SSR may request that site operations be temporarily suspended while the underlying hazard is corrected or controlled. During operation shutdown, all personnel will be required to stand upwind to prevent exposure to fugitive emissions. The IHT will have ultimate authority for operations shutdown and restart. (Restart may require concurrence from the Contracting Officer.)

13.9 DISTRIBUTION OF THIS EMERGENCY RESPONSE PLAN

A copy of this emergency response plan will be distributed to all of the local emergency services, all applicable Federal, state, and local regulatory agencies, and made available to all site personnel. A copy of this emergency response plan will also be distributed to the EC, Backup ECs, the Site Supervisor, and the Contracting Officer.

13.10 PROCEDURES FOR PLAN REVIEW AND AMENDMENT

This emergency response plan will reviewed and amended as necessary if either one of the following happens:

- The plan fails in an emergency.
- The site changes in its design, construction, operation, maintenance, or other circumstances-in a way that materially increases the potential for fires, explosions, or releases of hazardous waste of hazardous waste constituents, or changes the response necessary in an emergency.
- The emergency coordinators change.

Changes to this Emergency Response Plan will be made by the EC, CIH and the Contracting Officer if any of the above mentioned occurs. Revised copies of this ER shall be distributed to all personnel outlined in Section 13.9.

14.0 ACCIDENT PREVENTION PROGRAM

14.1 RESPONSIBILITIES

The IHT and Subcontractor Safety Representative will implement this accident prevention program at the Carswell AFB project site. The IHT and SSRs are responsible for seeing that this plan is implemented and followed by all contractor personnel.

The IHT and SSRs are responsible for being thoroughly familiar with:

- The SSHP and this accident prevention program.
- All operations and activities associated with the project.
- The safe work practices to be implemented during remedial activities.
- The chemical and physical hazards associated with remedial activities.
- Accident and incident reporting and investigations requirements.
- The location of all emergency equipment including fire extinguishers.
- First aid and medical facilities to be used in case of an accident, and the names and locations of site personnel who are trained in first aid and CPR.
- The location of all operation-specific records.
- The physical layout of the facility.

Additional responsibilities for accident prevention and site health and safety activities are outlined in Section 3.0 entitled "Safety Program Administration" of this SSHP.

14.2 SAFETY HAZARDS TO BE EXPECTED

The safety hazards to be expected at the site during remedial activities include those associated with the following activities:

- Heat stress associated with hot environments and the use of personal protective clothing;

- Heavy equipment operations including the use of trucks, cranes, backhoes, trackhoes, loaders, graders, and compactors;
- Noise exposure associated with the use of heavy equipment, mechanical equipment, electrical equipment, and hand tools;
- Electrical hazards associated with underground and overhead high voltage lines and utilities;
- Slip, trip, and fall type of hazards associated with open excavations and uneven working surfaces;
- Mechanical injuries from hard tools;
- Chemical hazards associated with contaminated soil and materials located at the Carswell AFB site; and
- Being struck by moving heavy equipment.

Specific information concerning the above safety hazards and methods to control these hazards is located in Section 4.0 entitled "Hazard Assessment" of this SSHP.

14.3 PHASE-SPECIFIC SAFETY PROCEDURES

Remedial activities at the Carswell AFB project have not been divided into separate phases. For the sake of this accident prevention plan, remedial activities have been separated into two main categories of activities. The first category is removal of the contaminated soil and debris in SWMU 19, 20, and 53, and the second is bioremediation of contaminated soils removed from SWMU 19, 20, and 53.

During the removal of contaminated soil from the SWMUs, the following safety procedures and activities will be conducted:

- Heat and cold stress monitoring;
- Air monitoring activities for personal exposure to petroleum hydrocarbons;
- Evaluation of PPE and respiratory protection requirements in relation contaminant concentrations and air monitoring results;

- Implementation of engineering controls in the work area (dust control and vapor emission control) to control personal exposure to chemical contaminants;
- Implementing decontamination procedures when leaving the exclusion zone to remove contamination from personal protective equipment;
- Practicing good personal hygiene by washing hands and face prior to eating, drinking, smoking, and using the restroom; and
- Following the safe work practices outlined for work around heavy equipment, hand tools, and electrical lines.

Safety procedures to be followed during bioremediation activities will include the following:

- Heat and cold stress monitoring;
- Air monitoring activities for personal exposure to petroleum hydrocarbons;
- Evaluation of PPE and respiratory protection requirements in relation contaminant concentrations and air monitoring results;
- Implementation of engineering controls in the work area (using sprinklers for dust control) to control personal exposure to chemical contaminants;
- Implementing decontamination procedures when leaving the exclusion zone to remove contamination from personal protective equipment; and
- Following the safe work practices outlined for work around heavy equipment.

For specific information regarding the above listed safety controls, please see Section 4.0 through 12.0 of this SSHP.

14.4 SUBCONTRACTOR SUPERVISION

The Contractor's Project Manager, Certified Industrial Hygienist, and Industrial Hygiene Technician are responsible for implementing the provisions of this site safety and health plan for all Contractor personnel. Each subcontractor is responsible for appointing a Subcontractor Safety Representative (SSR) who is responsible for supervising subcontractor personnel and ensuring that all provisions of this plan are implemented effectively. If subcontractor personnel are observed to be

conducting work in an unsafe manner, then the PM, CIH, and IHT have the authority to stop work until the problem is rectified. The SSR is also responsible for immediately reporting site injuries and illnesses to the IHT and PM.

14.5 FIRE PREVENTION AND PROTECTION

To protect against fires, the following special precautions must be taken:

- No flame-producing devices or other uncontrolled ignition sources shall be used in the exclusion zone unless the atmosphere has been tested for flammable vapors as outlined in Section 7.1.1 of this SSHP;
- Any hot work outside of the support zone can only be done in an area that has been cleared of brush and other flammable materials for a distance of 15 feet;
- A fire watch will be posted for the duration of any hot work. The fire watch will have no other duties while on fire watch;
- Two full 20 pound ABC fire extinguishers must be located at the work area when hot work is being conducted; and
- Upon completion of the hot work activities the area will be inspected for hot metal, slag, hot spots, etc.

Type ABC fire extinguishers will be available onsite to contain and extinguish small fires. The local fire department shall be summoned (911) in the event of any fire on site. The nearest fire station should be notified of operations prior to their commencement.

14.6 SITE HOUSEKEEPING

To complete the first requirement for safe field operations, the IHT and the subcontractor safety representatives must understand and fulfill their responsibility for maintenance and "housekeeping" at the site.

Work areas, platforms, walkways, scaffolding, and other access ways will be kept free of materials, obstructions, and substances such as ice, excess grease, or oil that could cause a surface to become slick or otherwise hazardous. Keep all equipment controls, control linkages, and warning and operation lights and lenses free of oil, grease, and/or ice.

Suitable storage locations will be provided for all tools, materials, and supplies. The locations shall allow for the convenient handling of tools, materials or supplies without danger that these could fall on or hit anyone.

Do not store gasoline in any portable container other than a non-sparking, red container with a flame arrestor in the fill spout. The word "gasoline" must be clearly visible on the container.

14.7 MECHANICAL EQUIPMENT INSPECTION

All heavy equipment shall be inspected at least monthly by the equipment operators and before each shift, equipment will be inspected to see that it is in a safe operating condition. The following parts and equipment should be inspected:

1. Brakes, including trailer brake connections
2. Parking and emergency brakes
3. Tires
4. Horns
5. Steering mechanisms
6. Coupling devices
7. Seat belts
8. Operating controls
9. Lights, reflectors, windshield wipers, defrosters, fire extinguishers, back-up alarms, and other safety devices.

14.8 FIRST AID AND MEDICAL FACILITIES

The IHT and at least one subcontractor safety representative for each work area will hold a current certificate in American Red Cross Standard First Aid. This training provides four hours of Adult CPR and four hours of Basic First Aid. If a medical emergency exists consult the emergency phone number list located in Section 13.3.3 and request an ambulance immediately. Perform First Aid/CPR as necessary, stabilize the injured, decontaminate if necessary, and extricate only if the environment they

are in is dangerous or unsafe and ONLY if the rescuers are appropriately protected for potential hazards they may encounter during the rescue. When emergency services personnel arrive, communicate all first aid activities that have occurred. Transfer responsibility for care of the injured/ill to the emergency services personnel. Additional first aid requirements are located in Section 13.7 entitled "Emergency Medical Treatment and First Aid".

Two emergency medical facilities are located near the Carswell AFB and are available for use by Contractor personnel. The closest hospital is the R.L. Thorton Strategic Hospital. This hospital has emergency medical services that can respond within three minutes of the work area, and the All Saints Episcopal Hospital has emergency services that can respond within 10 minutes of the work area. All the hospital information including the phone numbers and directions are located in Section 13.3.3 entitled "Emergency Services Information".

14.9 SANITATION

Potable water will be made available at the site, either from a pressurized source or commercially-available bottled water. Drinking cups will be supplied so personnel will neither drink directly from the source of water nor have to share drinking cups. Sources of non-potable water shall be clearly labeled as such.

Unless toilet facilities are available on site or transportation is readily available to transport personnel to nearby (within five minutes) toilet facilities, portable toilet facilities, such as chemical toilets, will be provided on site.

Washing facilities will be provided on site, and will be located in the decontamination area or the support area. Soap, clean water, wash basins and single-use towels will be available for personnel use.

Lunch and break areas will be designated prior to the commencement of work, and will be located in the support zone. Site personnel are required to wash their face and hands prior to eating, drinking, and smoking. All breaks will be taken in the designated lunch and break areas. Eating, drinking, smoking and applying cosmetics is strictly prohibited in the work area.

14.10 RECORDKEEPING AND INCIDENT REPORTING

The investigation and reporting of occupational injuries, illnesses and dangerous occurrences is essential for project management is to be able to take the steps necessary to avoid additional injuries or illnesses. A complete investigation will provide information regarding the elements of the incident and the process by which they came together to cause the injury, illness, or dangerous occurrence. By

identifying the elements and processes, further incidents can be avoided. Timely reporting also permits project contractors to remain in compliance with OSHA recordkeeping regulations.

14.10.1 Program Responsibilities

The Certified Industrial Hygienist will:

- Determine if an incident warrants a formal investigation, and conduct incident investigations as required.
- Provide reports of formal investigations to the PM or Contracting Officer.
- Review all accident reports.
- Maintain the project OSHA Form 200.

The Project Manager, or his designee, will:

- Investigate all incidents on his projects.
- Complete and submit reports in accordance with this Procedure.

Site personnel are responsible for reporting ALL incidents involving injuries or illnesses, including near-misses, to their supervisor in a timely fashion (i.e., within 1 working day.)

14.10.2 Accident and Illness Investigation

Sometimes the investigation of an accident or illness is necessary to prevent similar occurrences. Investigation should not attempt to prove guilt or innocence; rather its purpose should be to ascertain the existence of hazards by identifying the elements and sources which caused the accident or illness. Additionally, a proper investigation should result in the identification of any corrective measures which may be required.

The objectives of an accident or illness investigation are to:

- Determine the existence of any hazards or contributing factors involved.
- Make recommendations for eliminating the hazards.

- Determine if any unsafe or unhealthful behavior or condition was involved.
- Make recommendations for eliminating the unsafe or unhealthful condition or behavior involved.

14.10.3 Responsibilities For An Accident or Illness Investigation

Accident or illness investigations require a search for all factors involved in the accident or illness. Every factor must be found, evaluated and considered in order to determine what actually occurred and why. Failure to gather and consider all factors could allow recurrent accidents or illnesses from the same cause.

When a Supervisor is advised that an accident or illness has occurred, he should:

- Immediately notify the Contracting Officer.
- Complete the appropriate Accident Report Forms.
- Investigate promptly.
- Determine what happened and how it happened.
- Determine the results.
- Determine what immediate corrective action to take.
- Notify the CIH and IHT and request assistance, if needed.

When the CIH or IHT is advised that an accident or illness has occurred, the CIH will determine if a formal investigation is required. If it is, the following steps should be observed:

- Immediately notify the Contracting Officer.
- Conduct an investigation promptly.
- Collect and weigh all facts, and justify the conclusions reached by the evidence.
- Determine familiarity by the employee with equipment and procedures involved.
- Determine the conditions or situations relative to the cause of the accident or illness.

- Determine if the accident or illness was caused by a physical hazard or by an unsafe act.
- Assign one or more persons to investigate major lost time accidents or illnesses.
- Be objective and independent from the individuals or programs involved in the accident or illness.

14.10.4 Incident/Accident Reporting

In the event of an injury or illness, work is to be stopped until the cause of the incident has been determined and appropriate action has been taken. Any injury or illness, regardless of severity, is to be reported on the accident report forms located in Attachment C.

In addition to filling out the appropriate OSHA Accident Report Forms, the U.S. Army Corps of Engineers requires that a ENG Form 3394 be filled out for any accident or injury that occurs on the Carswell AFB property. These requirements are as follows:

- (1) Report all accidents or injuries on an ENG form 3394 which is located in Attachment C.
- (2) Notify within 24 hours of the event.
- (3) Report within (2) working days sufficient information to allow completion of ENG 3394 in accordance with AR 385-40 and USACE Supplement 1 to that regulation. The report will contain the following information:
 - (a) First Aid
 - (b) Lost-Time
 - (c) Property damage; 1,000 dollars or more to government or contractor property.
 - (d) 50,000 dollars or more damage to government or contractor property, requires an immediate board investigation.
 - (e) Questionable property damage.
 - (f) Fatalities or 5 or more people taken to a hospital with injuries requiring an overnight stay.

Immediate (48 hour) reporting to OSHA is required under 29 CFR 1904 if a fatality or catastrophe (5 or more people sent to the hospital with injuries that require an overnight stay.) occurs. All other personal injuries requiring first aid or resulting in lost time will be reported on an OSHA Form 200.

14.10.5 Recordkeeping

OSHA Form 200, the Log and Summary of Occupational Injuries and Illnesses, is maintained for the project by the CIH. This function is centralized to ensure that a uniform procedure is used for the completion and distribution of Form 200.

The CIH has 5 workdays from the date of the occurrence of the recordable injury or illness to make the appropriate entries in the log. Therefore, the supervisor must complete the Accident Report Form immediately upon report and initial investigation of the incident and forward a copy to the CIH.

The CIH will complete an OSHA Report of Occupational Injury or Illness and will update the site's Form 200 using the information from the OSHA Form 101. The OSHA Form 101 is the employers first report of occupational injury. The CIH will also need to know how many days the affected individual was off duty and/or on restricted duty in order to complete the update.

At the end of each calendar year, an annual summary of occupational injuries and illnesses for that year will be prepared. The summary must be posted for the entire month of February in the year following the summary year. The posted summary shall not show the names of the personnel whose illnesses or injuries are listed.

The log and summary, Form 200, and the accident reports, Form 101, must be retained at the site for 5 years. All OSHA records will be made available upon request for inspection and copying by authorized Federal and State government officials. Site personnel, former site personnel, and representatives are provided access only to the log, Form 200. Access to these records will be provided in a reasonable manner and at a reasonable time.

14.11 SAFETY MEETINGS, INSPECTIONS AND REPORTS

14.11.1 Daily Health and Safety Inspections and Reports

The IHT will keep and fill out a daily log and safety inspection report which will record daily safety and health discrepancies, issues brought to the supervisor's attention, and general safety and health related concerns. This report will include the following data:

- Date and place;
- Area (specific zone);
- Number of employees in each area;

- Equipment being used in each area;
- Special health and safety issues noted; and
- IHT signature and date.

Site safety briefings will be conducted at least weekly with all Contractor personnel to discuss problems observed during the previous week such as improper use of respirators or protective clothing, violation of decontamination procedures, and other variances from the SSHP. The briefing will also discuss the hazards associated with additional chemicals brought onsite by contractor personnel. The IHT will also provide special training when unanticipated problems or changes in cleanup operations occur and to new employees as needed.

14.11.2 Weekly Health and Safety Reports

A health and safety report will be prepared by the IHT and submitted to the Contracting Officer on a weekly basis. The weekly report will include the following items:

- A summary sheet covering the work being performed;
- Copies of the daily health and safety inspection report;
- Results of air monitoring and screening performed during the previous week;
- Copies of correspondence; and
- IHT signature and date.

14.11.3 Phase-Out Report

The CIH and IHT will compile a phase-out report at completion of the project. This report will contain the following information:

- A summary of the project;
- A summary of health and safety activities reported throughout the duration of the project;
- Copies of the physician's written opinions and the physician's final written report. (The Specifications require that copies of final physical exams and medical records be turned in as part of the phase-out report. This activity clearly violates the physician/patient relationship and will not be performed);
- Copies of all analytical reports received from laboratories;

- Copies of the air monitoring field log;
- Copies of all air monitoring calibration records;
- Copies of all chain-of-custody records maintained for air samples; and
- Copies of all raw data collection sheets used during air monitoring.

This phase-out report will be reviewed and approved by the CIH prior to submittal to the Contracting Officer.

14.12 ACTIVITY HAZARD ANALYSIS

A complete activity hazard analysis is located in Section 4.0 entitled "Hazard Assessment" of this SSHP.

14.13 SAFE WORK PRACTICES

The following safe work practices will be observed during all field activities:

1. Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the contaminated or potentially contaminated area or where the possibility for the transfer of contamination exists.
2. All personnel will enter designated work areas only through the contamination reduction zone (CRZ). All personnel leaving an exclusion/work zone must exit through the CRZ and pass through the decontamination station as described in 9.0.
3. Personnel will wash their hands and face thoroughly with soap and water prior to eating, drinking or smoking.
4. Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, etc. Avoid, whenever possible, kneeling on the ground, leaning or sitting on equipment or ground. Do not place monitoring equipment on potentially contaminated surfaces (i.e., ground, etc.)
5. All field crew members should make use of their senses to alert them to potentially dangerous situations in which they should not become involved (i.e., presence of strong, irritating or nauseating odors).

6. Only those vehicles and equipment required to complete work tasks should be permitted within the exclusion/work zone (drill rigs, excavators, and similar items). All non-essential vehicles should remain within the support zone.
7. Containers, such as drums, will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.
8. Field survey instruments, such as OVAs and CGIs, will be covered with plastic or similar covering to minimize the potential for contamination.
9. No matches or lighters will be permitted in the work area/exclusion zone or contamination reduction zone.
10. Contaminated protective equipment, such as respirators, hoses, boots and disposable protective clothing, will not be removed from the work area/exclusion zone or decontamination area until it has been cleaned, or properly packaged and labeled.
11. Prevent, to the extent possible, spillages. In the event that a spillage occurs, contain liquid if possible.
12. Prevent splashing of the contaminated materials.
13. Field crew members shall be familiar with the physical characteristics of investigations, including:
 - Wind direction in relation to contaminated area;
 - Accessibility to equipment and vehicles;
 - Communications;
 - Areas of known or suspected contamination;
 - Site access; and
 - Nearest water sources.

14. The number of personnel and equipment in the contaminated area should be minimized but only to the extent consistent with workforce requirements of safe site operations.
15. All wastes generated during Contractor activities at the site will be disposed of as directed by the PM.
16. All personal protective equipment will be used as specified and required.
17. The buddy system will be used at all times when performing sampling for hazardous material when the first action level criteria has been exceeded or when working in remote areas.
18. Personnel are to immediately notify the IHT if any indications potential explosions, or unusual conditions are observed.

14.14 MATERIALS HANDLING PRACTICES

The Contractor will follow the safe handling procedures and practices listed below during the handling and transportation of hazardous materials:

- Proper and safe clearances will be maintained for material handling equipment on roadways, in loading areas, and wherever turns or passages are made;
- All roadways will be kept in good repair and free of debris that could create a hazard;
- Permanent roadways are marked;
- Covers, guard rails, and markers are in place to protect personnel from open pits, ditches, and other hazards;
- Employees are a safe distance from heavy equipment used to remove materials and from trucks in the TLZ when contaminated soil is being loaded onto the trucks;
- Truck exteriors are not contaminated when leaving the site; and
- Dust emissions are kept to a minimum.

14.15 HEALTH AND SAFETY EQUIPMENT LIST

Hardhats
Ear plugs or muffs
Disposable, one-piece Saranex Tyvek® coverall
Nitrile inner gloves
Butyl outer gloves
Work Gloves
Safety glasses
Goggles and/or faceshields for liquid exposure
Chemical resistant boots with steel toe and shank
Rain Gear
Plastic sheeting (visqueen)
55 gal 17-H drums (for contaminated solids) and 17-E drums (for liquids)
Drum liners
Barricade tape and barricades
Wash tubs and scrub brushes
Decon solution (i.e., TSP or alconox)
Folding chairs
Portable work table
Portable eyewash
Portable two-way radios
Respirator sanitizing equipment
First Aid kit
Drinking water and water cooler
Gatorade or similar drink
Ice chest and ice
Drinking Cups
Type ABC fire extinguishers
Full-face respirators (NIOSH/MSHA approved)
Organic vapor cartridges
Foxboro Organic Vapor Analyzer (OVA) and calibration kit
Combustible Gas Indicator and calibration kit
SKC Industrial Hygiene Sampling Pumps, Gilibrator, and sampling media
Power generator
Steam cleaner
Garden sprayer
Compressed gas horn
Duct tape

212134

Dining canopy

Trash bags

Paper towels

Camera and film

Port-a-Toilet

Mobile phone

15.0 SPILL CONTROL

15.1 NOTIFICATION OF SPILLS AND DISCHARGES

Prior to commencing excavation activities, the Project Manager is to contact the chief at the nearest fire station. A copy of this SSHP will be offered to the fire chief, and the PM will explain the operation, the potential risks to the community and facility personnel in the event of a significant release of hazardous materials; evacuation routes, procedures and signals should also be discussed.

If a spill occurs and humans or the environment are threatened, Contractor personnel will immediately contact the IHT or PM who in turn will immediately notify the Contracting Officer and the local Fire Department.

After spill response activities are completed, a Spill Report will be issued to the Contracting Officer. This spill report will identify the cause and extent of the spill, any resulting contamination danger, and the corrective actions taken by Contractor and emergency personnel.

15.2 REQUIRED EQUIPMENT

The following equipment will be kept at the site at all times to provide for the means to clean up an unexpected spill or discharge:

- Sand, clean fill, or other noncombustible absorbent (1/2 cubic yard)
- Front-end loader
- 55 gallon U.S. DOT 17-E and 17-H drum
- Shovels
- Any spill of a quantity that would require the use of Level B PPE will be referred to an emergency response contractor for cleanup.

15.3 SPILL CONTROL

If a spill occurs at the site, the following actions will be immediately taken by the Contractor:

- Notify the Contracting Officer;

- Isolate and contain the hazardous spill area;
- Do not allow anyone to touch or approach the spilled material without wearing the appropriate PPE;
- Direct personnel to stay upwind of the spill location, and to keep out of low areas;
- Keep combustibles away from the spilled material;
- Use water spray to reduce vapors and dust as needed;
- Collect samples for analysis to assess if cleanup activities were adequate; and
- Conduct any other actions as needed.

If solid material is spilled at the Carswell AFB project site, the spilled material will be removed and placed into a dry container and labeled for disposal.

If a liquid material is spilled, the spilled material will be absorbed with sand, clean fill, or noncombustible absorbent material. Once absorbed, the material will be placed into dry containers and labeled for disposal.

15.4 DISCHARGES

If a discharge of any material stored in a drum or container occurs, the following actions will be taken:

- Notify the Contracting Officer;
- Take immediate measures to control the discharge;
- Contain and eliminate the discharge;
- Remove or retrieve any discharged liquids;
- Isolate the hazardous area and deny entry to unauthorized personnel; and
- Do not allow anyone to touch or approach the discharged material.

For liquid discharges to soil, the Contractor will immediately identify the point of discharge, and take measures to eliminate further spills. The discharged material will be absorbed with sand, clean fill, or noncombustible absorbent material, and the absorbent discharged mixture will be placed in dry containers and labeled for disposal.

15.5 DECONTAMINATION

After the spill or discharge area has been controlled, personnel will undergo decontamination procedures as outlined in Section 12.

Each worker will be responsible for cleaning, sanitizing and storing their own respirator in accordance with manufacturer's guidance (i.e., washing in warm water and detergent or sanitizing solution, air drying, and storing in a plastic storage bag. Cartridges will be changed as soon as breakthrough occurs (detection of organic vapor odor while wearing the respirator) and at the end of each shift. Respirators will be kept in storage bags or boxes when not in use.

When all work activities have been completed, contaminated tools used by Contractor personnel will be either completely decontaminated or properly disposed as hazardous waste.

It is expected that all tools will be constructed of non-porous, non-absorbent materials. This will aid the decontamination process. Any tool, or part of a tool, which is made of a porous/absorbent material will be discarded and disposed of as a hazardous waste if it cannot be properly decontaminated.

Tools will be placed on a decontamination pad or into a bucket and thoroughly washed using a soap solution and brushing, followed by a fresh water rinse. All visible particles are to be removed before the tool is considered clean.

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ATTACHMENT A

COMPLIANCE AGREEMENT FORM

ATTACHMENT A

SAFETY PLAN COMPLIANCE AGREEMENT

FOR

CARSWELL AFB PROJECT

FORT WORTH, TEXAS

I, _____, have received a copy of the Health and Safety Plan for the Project. I have reviewed the plan, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the health and safety requirements specified in the plan.

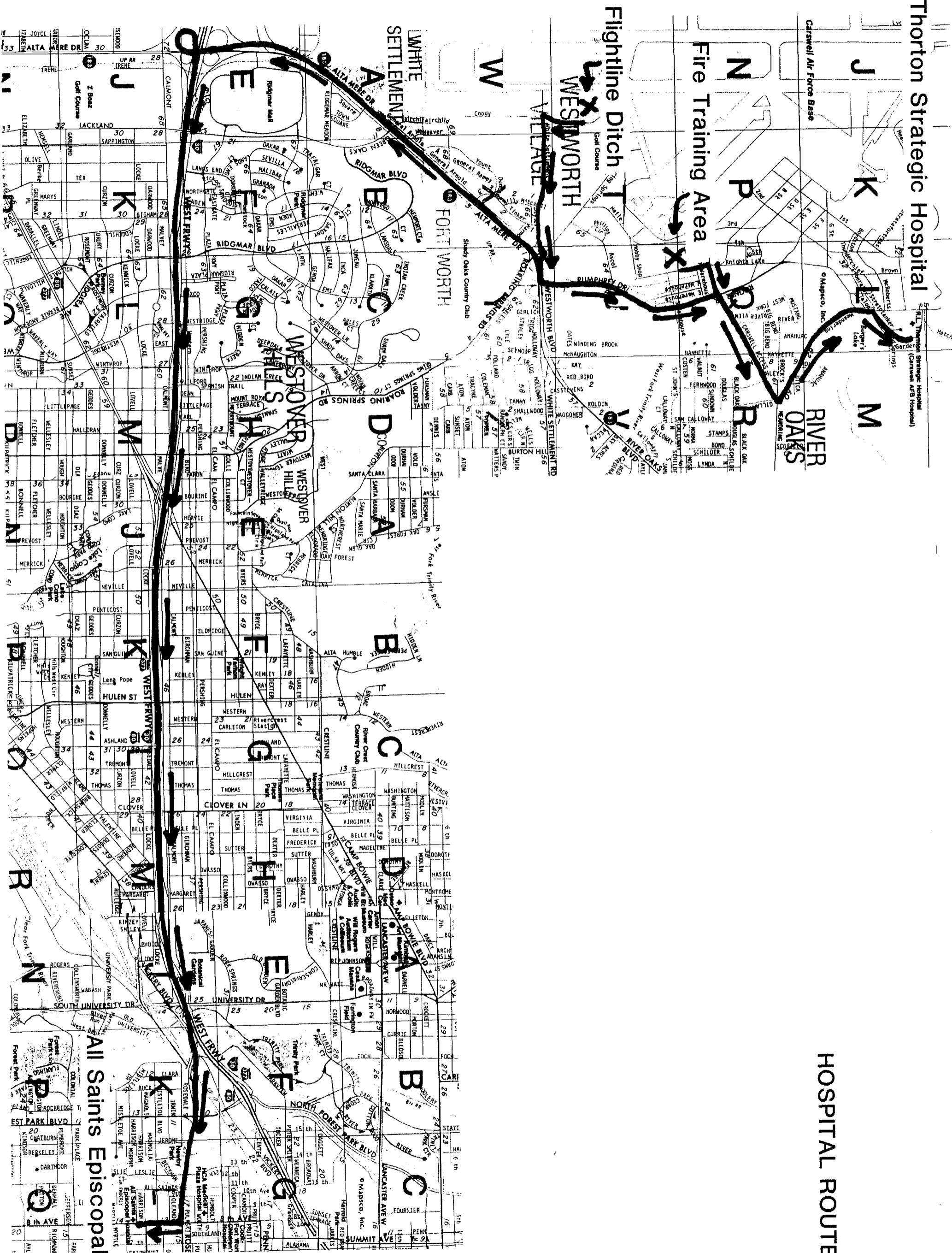
SIGNED:

(Signature)_____
(Date)

Firm:

ATTACHMENT B

HOSPITAL ROUTE MAP



212140

ATTACHMENT C

ACCIDENT REPORT FORMS

212143

ACCIDENT/EXPOSURE REPORT

EMPLOYEE NAME _____ DATE OF BIRTH _____
HOME ADDRESS _____ PHONE NO. _____
SEX: MALE _____ FEMALE _____ JOB TITLE _____ SOCIAL SECURITY NO. _____
OFFICE NO. _____ OFFICE LOCATION _____ DATE OF HIRE _____
HOURS USUALLY WORKED: HOURS PER DAY _____ HOURS PER WEEK _____ TOTAL HOURS WEEKLY _____

WHERE DID ACCIDENT OR EXPOSURE OCCUR? (INCLUDE ADDRESS) _____

COUNTY _____ ON EMPLOYER'S PREMISES? YES _____ NO _____

WHAT WAS EMPLOYEE DOING WHEN INJURED? (BE SPECIFIC) _____

HOW DID THE ACCIDENT OR EXPOSURE OCCUR? (DESCRIBE FULLY) _____

WHAT STEPS COULD BE TAKEN TO PREVENT SUCH AN OCCURRENCE? _____

OBJECT OR SUBSTANCE THAT DIRECTLY INJURED EMPLOYEE _____

DESCRIBE THE INJURY OR ILLNESS _____ PART OF BODY AFFECTED _____

NAME AND ADDRESS OF PHYSICIAN _____

IF HOSPITALIZED, NAME AND ADDRESS OF HOSPITAL _____

DATE OF INJURY/ILLNESS _____ TIME OF DAY _____ LOSS OF ONE OR MORE DAY OF WORK? YES/NO _____

IF YES-DATE LAST WORKED _____

HAS EMPLOYEE RETURNED TO WORK? _____ IF YES-DATE RETURNED _____ DID EMPLOYEE DIE? _____ IF YES-DATE _____

COMPLETED BY (PRINT) _____ SIGNATURE _____

TITLE _____ DATE _____

An accident/exposure report must be completed by the supervisor or site safety officer immediately upon learning of the incident.

or Staff only		REPORT NO. _____ EROC CODE _____		UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT <i>(For Use of this Form See Attached Instructions and USACE Suppl to AR 385-40)</i>			REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)		
ACCIDENT CLASSIFICATION									
PERSONNEL CLASSIFICATION <input type="checkbox"/> GOVERNMENT <input type="checkbox"/> CIVILIAN <input type="checkbox"/> MILITARY		INJURY/ILLNESS/FATAL <input type="checkbox"/>		PROPERTY DAMAGE <input type="checkbox"/> FIRE INVOLVED <input type="checkbox"/> OTHER		MOTOR VEHICLE INVOLVED <input type="checkbox"/>		DIVING <input type="checkbox"/>	
<input type="checkbox"/> CONTRACTOR		<input type="checkbox"/>		<input type="checkbox"/> FIRE INVOLVED <input type="checkbox"/> OTHER		<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/> PUBLIC		<input type="checkbox"/> FATAL <input type="checkbox"/> OTHER		X		<input type="checkbox"/>		X	
PERSONAL DATA									
a. NAME (Last, First, MI) _____			b. AGE _____	c. SEX <input type="checkbox"/> MALE <input type="checkbox"/> FEMALE		d. SOCIAL SECURITY NUMBER _____			e. GRADE _____
f. JOB SERIES/TITLE _____		g. DUTY STATUS AT TIME OF ACCIDENT <input type="checkbox"/> ON DUTY <input type="checkbox"/> TDY <input type="checkbox"/> OFF DUTY			h. EMPLOYMENT STATUS AT TIME OF ACCIDENT <input type="checkbox"/> ARMY ACTIVE <input type="checkbox"/> ARMY RESERVE <input type="checkbox"/> VOLUNTEER <input type="checkbox"/> PERMANENT <input type="checkbox"/> FOREIGN NATIONAL <input type="checkbox"/> SEASONAL <input type="checkbox"/> TEMPORARY <input type="checkbox"/> STUDENT <input type="checkbox"/> OTHER (Specify) _____				
GENERAL INFORMATION									
a. DATE OF ACCIDENT (month/day/year) _____		b. TIME OF ACCIDENT (Military time) _____		c. EXACT LOCATION OF ACCIDENT _____			d. CONTRACTOR'S NAME (1) PRIME: _____ (2) SUBCONTRACTOR _____		
e. CONTRACT NUMBER <input type="checkbox"/> CIVIL WORKS <input type="checkbox"/> MILITARY <input type="checkbox"/> OTHER (Specify) _____		f. TYPE OF CONTRACT <input type="checkbox"/> CONSTRUCTION <input type="checkbox"/> SERVICE <input type="checkbox"/> A/E <input type="checkbox"/> DREDGE <input type="checkbox"/> OTHER (Specify) _____		g. HAZARDOUS/TOXIC WASTE ACTIVITY <input type="checkbox"/> SUPERFUND <input type="checkbox"/> DERP <input type="checkbox"/> IRP <input type="checkbox"/> OTHER (Specify) _____					
CONSTRUCTION ACTIVITIES ONLY (Fill in line and corresponding code number in box from list - see instructions)									
a. CONSTRUCTION ACTIVITY _____ (CODE) # <input type="text"/>				b. TYPE OF CONSTRUCTION EQUIPMENT _____ (CODE) # <input type="text"/>					
INJURY / ILLNESS INFORMATION (Include name on line and corresponding code number in box for items e, f & g - see instructions)									
a. SEVERITY OF ILLNESS / INJURY _____ (CODE) # <input type="text"/>				b. ESTIMATED DAYS LOST _____	c. ESTIMATED DAYS HOSPITALIZED _____	d. ESTIMATED DAYS RESTRICTED DUTY _____			
e. BODY PART AFFECTED PRIMARY _____ (CODE) # <input type="text"/> SECONDARY _____ (CODE) # <input type="text"/>				g. TYPE AND SOURCE OF INJURY/ILLNESS TYPE _____ (CODE) # <input type="text"/> SOURCE _____ (CODE) # <input type="text"/>					
f. NATURE OF ILLNESS / INJURY _____ (CODE) # <input type="text"/>									
PUBLIC FATALITY (Fill in line and corresponding code number in box - see instructions)									
a. ACTIVITY AT TIME OF ACCIDENT _____ (CODE) # <input type="text"/>				b. PERSONAL FLOATATION DEVICE USED? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A					
MOTOR VEHICLE ACCIDENT									
a. TYPE OF VEHICLE <input type="checkbox"/> PICKUP/VAN <input type="checkbox"/> AUTOMOBILE <input type="checkbox"/> TRUCK <input type="checkbox"/> OTHER (Specify) _____		b. TYPE OF COLLISION <input type="checkbox"/> SIDE SWIPE <input type="checkbox"/> HEAD ON <input type="checkbox"/> REAR END <input type="checkbox"/> BROADSIDE <input type="checkbox"/> ROLL OVER <input type="checkbox"/> BACKING <input type="checkbox"/> OTHER (Specify) _____			c. SEAT BELTS (1) FRONT SEAT (2) REAR SEAT		USED <input type="checkbox"/>	NOT USED <input type="checkbox"/>	NOT AVAILABLE <input type="checkbox"/>
PROPERTY/MATERIAL INVOLVED									
a. NAME OF ITEM (1) _____ (2) _____ (3) _____			b. OWNERSHIP _____			c. \$ AMOUNT OF DAMAGE _____			
VESSEL / FLOATING PLANT ACCIDENT (Fill in line and corresponding code number in box from list - see instructions)									
a. TYPE OF VESSEL/FLOATING PLANT _____ (CODE) # <input type="text"/>				b. TYPE OF COLLISION/MISHAP _____ (CODE) # <input type="text"/>					
ACCIDENT DESCRIPTION (Use additional paper, if necessary)									

a. (Explain YES answers in item 13)

YES NO

DESIGN: Was design of facility, workplace or equipment a factor?

☐ YES ☐ NO

INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?

☐ YES ☐ NO

PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?

☐ YES ☐ NO

OPERATING PROCEDURES: Were operating procedures a factor?

☐ YES ☐ NO

JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?

☐ YES ☐ NO

HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?

☐ YES ☐ NO

ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?

☐ YES ☐ NO

a. (CONTINUED)

212145

YES NO

CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?

☐ YES ☐ NO

OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?

☐ YES ☐ NO

SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?

☐ YES ☐ NO

PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?

☐ YES ☐ NO

DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident?

☐ YES ☐ NO

b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES (If yes, attach a copy.)☐ NO

12

TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?

☐ YES ☐ NO

b. TYPE OF TRAINING.

☐ CLASSROOM ☐ ON JOB

c. DATE OF MOST RECENT FORMAL TRAINING.

/ /
(Month) (Day) (Year)

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES (See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)

a. DIRECT CAUSE

b. INDIRECT CAUSE(S)

14

ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).

DESCRIBE FULLY.

15

DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING (Month/Day/Year)

/ /

b. ANTICIPATED COMPLETION (Month/Day/Year)

/ /

c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT

CORPS

CONTRACTOR

d. DATE (Mo/Day/Yr)

/ /
/ /

e. ORGANIZATION IDENTIFIER (Div, Br, Sect)

f. OFFICE SYMBOL

16

MANAGEMENT REVIEW (1st).

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE

TITLE

DATE

17

MANAGEMENT REVIEW (2nd - Chief Operations, Construction, Engineering, etc.)

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE

TITLE

DATE

18

SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS.

SIGNATURE

TITLE

DATE

19

COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE

DATE

GENERAL. Complete a separate report for each person who was *injured, caused, or contributed* to the accident (excluding uninjured personnel and witnesses). Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs (OWCP) shall be at the discretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es). If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16. and 17.

INSTRUCTIONS FOR SECTION 1 — ACCIDENT CLASSIFICATION. (Mark All Boxes That Are Applicable.)

- a. **GOVERNMENT.** Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.
 - (1) **INJURY/ILLNESS/FATALITY** — Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 (injury), CA-2 (illness), or CA-6 (fatality) to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.
 - (2) **PROPERTY DAMAGE** — Mark the appropriate box if accident resulted in any damage of \$1000 or more to government property (including motor vehicles).
 - (3) **VEHICLE INVOLVED** — Mark if accident involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.
 - (4) **DIVING ACTIVITY** — Mark if the accident involved an in-house USACE diving activity.
- b. **CONTRACTOR.**
 - (1) **INJURY/ILLNESS/FATALITY** — Mark if accident resulted in any contractor lost-time injury/illness or fatality.
 - (2) **PROPERTY DAMAGE** — Mark the appropriate box if accident resulted in any damage of \$1000 or more to contractor property (including motor vehicles).
 - (3) **VEHICLE INVOLVED** — Mark if accident involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.
 - (4) **DIVING ACTIVITY** — Mark if the accident involved a USACE Contractor diving activity.
- c. **PUBLIC.**
 - (1) **INJURY/ILLNESS/FATALITY** — Mark if accident resulted in public fatality or permanent total disability. (The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander).
 - (2) **VOID SPACE** — Make no entry.
 - (3) **VEHICLE INVOLVED** — Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" is marked.
 - (4) **VOID SPACE** — Make no entry.

INSTRUCTIONS FOR SECTION 2 — PERSONAL DATA

- a. **NAME** — (MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS). Enter last name, first name, middle initial of person involved.
- b. **AGE** — Enter age.
- c. **SEX** — Mark appropriate box.
- d. **SOCIAL SECURITY NUMBER** — (FOR GOVERNMENT PERSONNEL ONLY) Enter the social security number (or other personal identification number if no social security number issued).
- e. **GRADE** — (FOR GOVERNMENT PERSONNEL ONLY) Enter pay grade. Example: O-6; E-7; WG-8; WS-12; GS-11; etc.

- f. **JOB SERIES/TITLE** — For *government civilian employees* enter the pay plan, full series number, and job title, e.g. GS-0810/Civil Engineer. For *military personnel* enter the primary military occupational specialty (PMOS), e.g., 15A30 or 11G50. For *contractor employees* enter the job title assigned to the injured person, e.g. carpenter, laborer, surveyor, etc.,
- g. **DUTY STATUS** — Mark the appropriate box.
 - (1) **ON DUTY** — Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.
 - (2) **TDY** - Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.
 - (3) **OFF DUTY** - Person was not on official business at time of accident
- h. **EMPLOYMENT STATUS** — (FOR GOVERNMENT PERSONNEL ONLY) Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3 — GENERAL INFORMATION

- a. **DATE OF ACCIDENT** — Enter the month, day, and year of accident.
- b. **TIME OF ACCIDENT** — Enter the local time of accident in military time. Example: 1430 hrs (not 2:30 p.m.).
- c. **EXACT LOCATION OF ACCIDENT** — Enter facts needed to locate the accident scene. (installation/project name, building number, street, direction and distance from closest landmark, etc.,).
- d. **CONTRACTOR NAME**
 - (1) **PRIME** — Enter the exact name (title of firm) of the prime contractor.
 - (2) **SUBCONTRACTOR** — Enter the name of any subcontractor involved in the accident.
- e. **CONTRACT NUMBER** — Mark the appropriate box to identify if contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.
- f. **TYPE OF CONTRACT** — Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.
- g. **HAZARDOUS/TOXIC WASTE ACTIVITY (HTW)** — Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program (IRP) HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site (FUDS) activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4 — CONSTRUCTION ACTIVITIES

- a. **CONSTRUCTION ACTIVITY** — Select the *most appropriate* construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

- | | |
|-------------------------|----------------------------|
| 1. MOBILIZATION | 14. ELECTRICAL |
| 2. SITE PREPARATION | 15. SCAFFOLDING/ACCESS |
| 3. EXCAVATION/TRENCHING | 16. MECHANICAL |
| 4. GRADING (EARTHWORK) | 17. PAINTING |
| 5. PIPING/UTILITIES | 18. EQUIPMENT/MAINTENANCE |
| 6. FOUNDATION | 19. TUNNELING |
| 7. FORMING | 20. WAREHOUSING/STORAGE |
| 8. CONCRETE PLACEMENT | 21. PAVING |
| 9. STEEL ERECTION | 22. FENCING |
| 10. ROOFING | 23. SIGNING |
| 11. FRAMING | 24. LANDSCAPING/IRRIGATION |
| 12. MASONRY | 25. INSULATION |
| 13. CARPENTRY | 26. DEMOLITION |

- b. **TYPE OF CONSTRUCTION EQUIPMENT**—Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

- | | |
|------------------------------------|--------------------------------|
| 1. GRADER | 13. DUMP TRUCK (OFF HIGHWAY) |
| 2. DRAGLINE | 14. TRUCK (OTHER) |
| 3. CRANE (ON VESSEL/BARGE) | 15. FORKLIFT |
| 4. CRANE (TRACKED) | 16. BACKHOE |
| 5. CRANE (RUBBER TIRE) | 17. FRONT-END LOADER |
| 6. CRANE (VEHICLE MOUNTED) | 18. PILE DRIVER |
| 7. CRANE (TOWER) | 19. TRACTOR (UTILITY) |
| 8. SHOVEL | 20. MANLIFT |
| 9. SCRAPER | 21. DOZER |
| 10. PUMP TRUCK (CONCRETE) | 22. DRILL RIG |
| 11. TRUCK (CONCRETE/TRANSIT MIXER) | 23. COMPACTOR/VIBRATORY ROLLER |
| 12. DUMP TRUCK (HIGHWAY) | 24. OTHER |

INSTRUCTIONS FOR SECTION 5—INJURY/ILLNESS INFORMATION

- a. **SEVERITY OF INJURY / ILLNESS** - Reference para 2-10 of USACE Suppl 1 to AR 385-40 and enter code and description from list below.

NOI NO INJURY
 FAT FATALITY
 PTL PERMANENT TOTAL DISABILITY
 PPR PERMANENT PARTIAL DISABILITY
 LWD LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
 NLW RECORDABLE CASE WITHOUT LOST WORKDAYS
 RFA RECORDABLE FIRST AID CASE
 NRI NON-RECORDABLE INJURY

- b. **ESTIMATED DAYS LOST**—Enter the estimated number of workdays the person will lose from work.
- c. **ESTIMATED DAYS HOSPITALIZED**—Enter the estimated number of workdays the person will be hospitalized.
- d. **ESTIMATED DAYS RESTRICTED DUTY**—Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.
- e. **BODY PART AFFECTED**—Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	CODE	BODY PART NAME
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH

	CN	NOSE
	CR	THROAT, OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EB	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER
HEAD, EXTERNAL	H1	EYE EXTERNAL
	H2	BOTH EYES EXTERNAL
	H3	EAR EXTERNAL
	H4	BOTH EARS EXTERNAL
	HC	CHIN
	HF	FACE
	HK	NECK/THROAT
	HM	MOUTH/LIPS
	HN	NOSE
	HS	SCALP
KNEE	KB	BOTH KNEES
	KS	KNEE
LEG, HIP, ANKLE, BUTTOCK	LB	BOTH LEGS/HIPS/ANKLES/BUTTOCKS
	LS	SINGLE LEG/HIP ANKLE/BUTTOCK
HAND	MB	BOTH HANDS
	MS	SINGLE HAND
FOOT	PB	BOTH FEET
	PS	SINGLE FOOT
TRUNK, BONES	R1	SINGLE COLLAR BONE
	R2	BOTH COLLAR BONES
	R3	SHOULDER BLADE
	R4	BOTH SHOULDER BLADES
	RB	RIB
	RS	STERNUM (BREAST BONE)
	RV	VERTEBRAE (SPINE; DISC)
	RZ	TRUNK BONES OTHER
SHOULDER	SB	BOTH SHOULDERS
	SS	SINGLE SHOULDER
THUMB	TB	BOTH THUMBS
	TS	SINGLE THUMB
TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
	V2	LUNGS, BOTH
	V3	KIDNEY, SINGLE
	V4	KIDNEYS, BOTH
	VH	HEART
	VL	LIVER
	VR	REPRODUCTIVE ORGANS
	VS	STOMACH
	VV	INTESTINES
	VZ	TRUNK, INTERNAL; OTHER

- f. **NATURE OF INJURY/ILLNESS** - Select the most appropriate nature of injury / illness from the list below. This nature of injury / illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury / illness name on the line and place the corresponding CODE letters in the box provided.

* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
*TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION
	TB	BACK STRAIN.
	TC	CONTUSION; BRUISE.
		ABRASION
	TD	DISLOCATION
	TF	FRACTURE
	TH	HERNIA
	TK	CONCUSSION
	TL	LACERATION, CUT
	TP	PUNCTURE
	TS	STRAIN, MULTIPLE
	TU	BURN, SCALD, SUNBURN
	TI	TRAUMATIC SKIN DISEASES/ CONDITIONS
		INCLUDING DERMATITIS
	TR	TRAUMATIC RESPIRATORY DISEASE
	TQ	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL/ INFECTIVE/PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER; STRESS; NERVOUS CONDITION
	T8	TRAUMATIC INJURY — OTHER (EXCEPT DISEASE, ILLNESS)

**A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which does not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
**NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	R9	RESPIRATORY DISEASE, OTHER
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC — OTHER
DISABILITY, OCCUPATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION; STROKE
	DD	ENDEMIC DISEASE (OTHER THAN CODE TYPES R&S)
	DE	EFFECT OF ENVIRONMENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER, EMOTIONAL STRESS NERVOUS CONDITION
	DR	RADIATION
	DS	STRAIN, MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY, OTHER

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
SKIN DISEASE OR CONDITION	SB	BIOLOGICAL
	SC	CHEMICAL
	S9	DERMATITIS, UNCLASSIFIED

g. TYPE AND SOURCE OF INJURY/ILLNESS (CAUSE) - Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident (see example 1, below). Examples:

- (1) An employee tripped on carpet and struck his head on a desk.
TYPE: 210 (fell on same level) SOURCE: 0110 (walking/working surface)

NOTE: This example would NOT be coded 120 (struck against) and 0140 (furniture).

- (2) A Park Ranger contracted dermatitis from contact with poison ivy/oak.
TYPE: 510 (contact) SOURCE: 0920 (plant)

- (3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.
TYPE: 410 (punctured by) SOURCE: 0830 (metal)

- (4) An employee was driving a government vehicle when it was struck by another vehicle..
TYPE: 800 (traveling in) SOURCE: 0421 (government-owned vehicle, as driver)

NOTE: The Type Code 800, "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	TYPE OF INJURY NAME
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL, SLIPPED, TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED, TRIPPED (NO FALL)
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED, LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH (INJURED PERSON MOVING)
0520	CONTACTED BY (OBJECT WAS MOVING)
	EXERTED
0610	LIFTED, STRAINED BY (SINGLE ACTION)
0620	STRESSED BY (REPEATED ACTION)
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN
CODE	SOURCE OF INJURY NAME
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE (FLOOR, STREET, SIDEWALKS, ETC)
0120	STAIRS, STEPS
0130	LADDER
0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0150	BOILER, PRESSURE VESSEL
0160	EQUIPMENT LAYOUT (ERGONOMIC)
0170	WINDOWS, DOORS
0180	ELECTRICITY

CODE	SOURCE OF INJURY NAME
0200	ENVIRONMENTAL CONDITION
0210	TEMPERATURE EXTREME (INDOOR)
0220	WEATHER (ICE, RAIN, HEAT, ETC.)
0230	FIRE, FLAME, SMOKE (NOT TOBACCO)
0240	NOISE
0250	RADIATION
0260	LIGHT
0270	VENTILATION
0271	TOBACCO SMOKE
0280	STRESS (EMOTIONAL)
0290	CONFINED SPACE
0300	MACHINE OR TOOL
0310	HAND TOOL (POWERED: SAW, GRINDER, ETC.)
0320	HAND TOOL (NONPOWERED)
0330	MECHANICAL POWER TRANSMISSION APPARATUS
0340	GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK)
0350	VIDEO DISPLAY TERMINAL
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL
0370	HEATING EQUIPMENT
0380	WELDING EQUIPMENT
0400	VEHICLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE
0421	DRIVER OF GOVERNMENT VEHICLE
0422	PASSENGER OF GOVERNMENT VEHICLE
0430	COMMON CARRIER (AIRLINE, BUS, ETC.)
0440	AIRCRAFT (NOT COMMERCIAL)
0450	BOAT, SHIP, BARGE
0500	MATERIAL HANDLING EQUIPMENT
0510	EARTHMOVER (TRACTOR, BACKHOE, ETC.)
0520	CONVEYOR (FOR MATERIAL AND EQUIPMENT)
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST
0540	HOIST, SLING CHAIN, JACK
0550	CRANE
0551	FORKLIFT
0560	HANDTRUCK, DOLLY
0600	DUST, VAPOR, ETC.
0610	DUST (SILICA, COAL, ETC.)
0620	FIBERS
0621	ASBESTOS
0630	GASES
0631	CARBON MONOXIDE
0640	MIST, STEAM, VAPOR, FUME
0641	WELDING FUMES
0650	PARTICLES (UNIDENTIFIED)
0700	CHEMICAL, PLASTIC, ETC.
0711	DRY CHEMICAL—CORROSIVE
0712	DRY CHEMICAL—TOXIC
0713	DRY CHEMICAL—EXPLOSIVE
0714	DRY CHEMICAL—FLAMMABLE
0721	LIQUID CHEMICAL—CORROSIVE
0722	LIQUID CHEMICAL—TOXIC
0723	LIQUID CHEMICAL—EXPLOSIVE
0724	LIQUID CHEMICAL—FLAMMABLE
0730	PLASTIC
0740	WATER
0750	MEDICINE
0800	INANIMATE OBJECT
0810	BOX, BARREL, ETC.
0820	PAPER
0830	METAL ITEM, MINERAL
0831	NEEDLE
0840	GLASS
0850	SCRAP, TRASH
0860	WOOD
0870	FOOD
0880	CLOTHING, APPAREL, SHOES
0900	ANIMATE OBJECT
0911	DOG
0912	OTHER ANIMAL
0920	PLANT
0930	INSECT
0940	HUMAN (VIOLENCE)
0950	HUMAN (COMMUNICABLE DISEASE)
0960	BACTERIA, VIRUS (NOT HUMAN CONTACT)

CODE	SOURCE OF INJURY NAME
1000	PERSONAL PROTECTIVE EQUIPMENT
1010	PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES
1020	RESPIRATOR, MASK
1021	DIVING EQUIPMENT
1030	SAFETY BELT, HARNESS
1040	PARACHUTE

212149

INSTRUCTIONS FOR SECTION 6 — PUBLIC FATALITY

- a. **ACTIVITY AT TIME OF ACCIDENT**—Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the *most* appropriate primary activity area (water related, non-water related or other activity), the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

- | | |
|-----------------------------------|--|
| 1. Sailing | 9. Swimming/designated area |
| 2. Boating—powered | 10. Swimming/other area |
| 3. Boating—unpowered | 11. Underwater activities (skin diving, scuba, etc.) |
| 4. Water skiing | 12. Wading |
| 5. Fishing from boat | 13. Attempted rescue |
| 6. Fishing from bank dock or pier | 14. Hunting from boat |
| 7. Fishing while wading | 15. Other |
| 8. Swimming/supervised area | |

NON-WATER RELATED RECREATION

- | | |
|--|---|
| 16. Hiking and walking | 23. Sports/summer (baseball, football, etc.) |
| 17. Climbing (general) | 24. Sports/winter (skiing, sledding, snowmobiling etc.) |
| 18. Camping/picnicking authorized area | 25. Cycling (bicycle, motorcycle, scooter) |
| 19. Camping/picnicking unauthorized area | 26. Gliding |
| 20. Guided tours | 27. Parachuting |
| 21. Hunting | 28. Other non-water related |
| 22. Playground equipment | |

OTHER ACTIVITIES

- | | |
|--|----------------------------------|
| 29. Unlawful acts (fights, riots, vandalism, etc.) | 33. Sleeping |
| 30. Food preparation/serving | 34. Pedestrian struck by vehicle |
| 31. Food consumption | 35. Pedestrian other acts |
| 32. Housekeeping | 36. Suicide |
| | 37. "Other" activities |

- b. **PERSONAL FLOTATION DEVICE USED**—If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7—MOTOR VEHICLE ACCIDENT

- a. **TYPE OF VEHICLE**—Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

- b. **TYPE OF COLLISION**—Mark appropriate box.

- c. **SEAT BELT**—Mark appropriate box.

INSTRUCTIONS FOR SECTION 8—PROPERTY/ MATERIAL INVOLVED

- a. **NAME OF ITEM**—Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number (NSN) whenever applicable.
- b. **OWNERSHIP**—Enter ownership for each item listed. (Enter one of the following: *USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE*)
- c. **\$ AMOUNT OF DAMAGE**—Enter the total estimated dollar amount of damage (parts and labor), if any.

INSTRUCTIONS FOR SECTION 9—VESSEL/ FLOATING PLANT ACCIDENT

212150

- a. TYPE OF VESSEL/FLOATING PLANT—Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel/floating plant.

VESSEL/FLOATING PLANTS

- | | |
|------------------------|-----------------------------|
| 1. ROW BOAT | 7. DREDGE/DIPPER |
| 2. SAIL BOAT | 8. DREDGE/CLAMSHELL, BUCKET |
| 3. MOTOR BOAT | 9. DREDGE/PIPE LINE |
| 4. BARGE | 10. DREDGE/DUST PAN |
| 5. DREDGE/HOPPER | 11. TUG BOAT |
| 6. DREDGE/SIDE CASTING | 12. OTHER |

- b. COLLISION/MISHAP—Select from the list below the object(s) that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

- | | |
|-----------------------------|-----------------------|
| 1. COLLISION W/OTHER VESSEL | 7. HAULAGE UNIT |
| 2. UPPER GUIDE WALL | 8. BREAKING TOW |
| 3. UPPER LOCK GATES | 9. TOW BREAKING UP |
| 4. LOCK WALL | 10. SWEEP DOWN ON DAM |
| 5. LOWER LOCK GATES | 11. BUOY/DOLPHIN/CELL |
| 6. LOWER GUIDE WALL | 12. WHARF OR DOCK |
| | 13. OTHER |

INSTRUCTIONS FOR SECTION 10—ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT—Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11—CAUSAL FACTORS

- a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

- (1) DESIGN—Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?
- (2) INSPECTION/MAINTENANCE—Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?
- (3) PERSON'S PHYSICAL CONDITION—Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?
- (4) OPERATING PROCEDURES—Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?
- (5) JOB PRACTICES—Were any of the provisions of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?

- (6) HUMAN FACTORS—Was the person under undue stress (either internal or external to the job)? Did the task tend toward overloading the capabilities of the person; i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

- (7) ENVIRONMENTAL FACTORS—Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

- (8) CHEMICAL AND PHYSICAL AGENT FACTORS—Did exposure to chemical agents (either single shift exposure or long-term exposure) such as dusts, fibers (asbestos, etc.), silica, gases (carbon monoxide, chlorine, etc.), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by-products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?

- (9) OFFICE FACTORS—Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

- (10) SUPPORT FACTORS—Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc?

- (11) PERSONAL PROTECTIVE EQUIPMENT—Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc.) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?

- (12) DRUGS/ALCOHOL—Is there any reason to believe the person's mental or physical capabilities, judgement, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

- b. WRITTEN JOB/ACTIVITY HAZARD ANALYSIS—Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. If one was performed, attach a copy of the analysis to the report.

INSTRUCTIONS FOR SECTION 12—TRAINING

- a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?—For the purpose of this section "trained" means the person has been provided the necessary information (either formal and/or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.

- b. TYPE OF TRAINING—Mark the appropriate box that best indicates the type of training; (classroom or on-the-job) that the injured person received before the accident happened.

- c. DATE OF MOST RECENT TRAINING—Enter the month, day, and year of the last formal training completed that covered the activity-task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13—CAUSES

212151

OFFICE SYMBOL—Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15.e.

- a. **DIRECT CAUSES**—The direct cause is that single factor which most directly lead to the accident. See examples below.
- b. **INDIRECT CAUSES**—Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

- a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.
Direct cause: failure to provide fall protection at elevation.
Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee (possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.
- b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. (note USACE vehicle was in proper/safe working condition).
Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.
Indirect cause: Failure of employee to pay attention to driving (defensive driving).

INSTRUCTIONS FOR SECTION 14—ACTION TO ELIMINATE CAUSE(S)

DESCRIPTION—Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15—DATES FOR ACTION

- a. **BEGIN DATE**—Enter the date when the corrective action(s) identified in Section 14 will begin.
- b. **COMPLETE DATE**—Enter the date when the corrective action(s) identified in Section 14 will be completed.
- c. **TITLE AND SIGNATURE**—Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE Supervisor shall also sign the report. Upon entering the information required in 15.d, 15.e and 15.f below, the responsible USACE supervisor shall forward the report for management review as indicated in Section 16.
- d. **DATE SIGNED**—Enter the month, day, and year that the report was signed by the responsible supervisor.
- e. **ORGANIZATION NAME**—For GOVERNMENT employee accidents enter the USACE organization name (Division, Branch, Section, etc.) of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15.c. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

INSTRUCTIONS FOR SECTION 16—MANAGEMENT REVIEW (1st)

1ST REVIEW—Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15.c shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief (2nd review) for review and comment.

INSTRUCTIONS FOR SECTION 17—MANAGEMENT REVIEW (2nd)

2ND REVIEW—The FOA Staff Chief (i.e., FOA Chief of Construction, Operations, Engineering, Planning, etc.) shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18—SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW—The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc. are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19—COMMAND APPROVAL

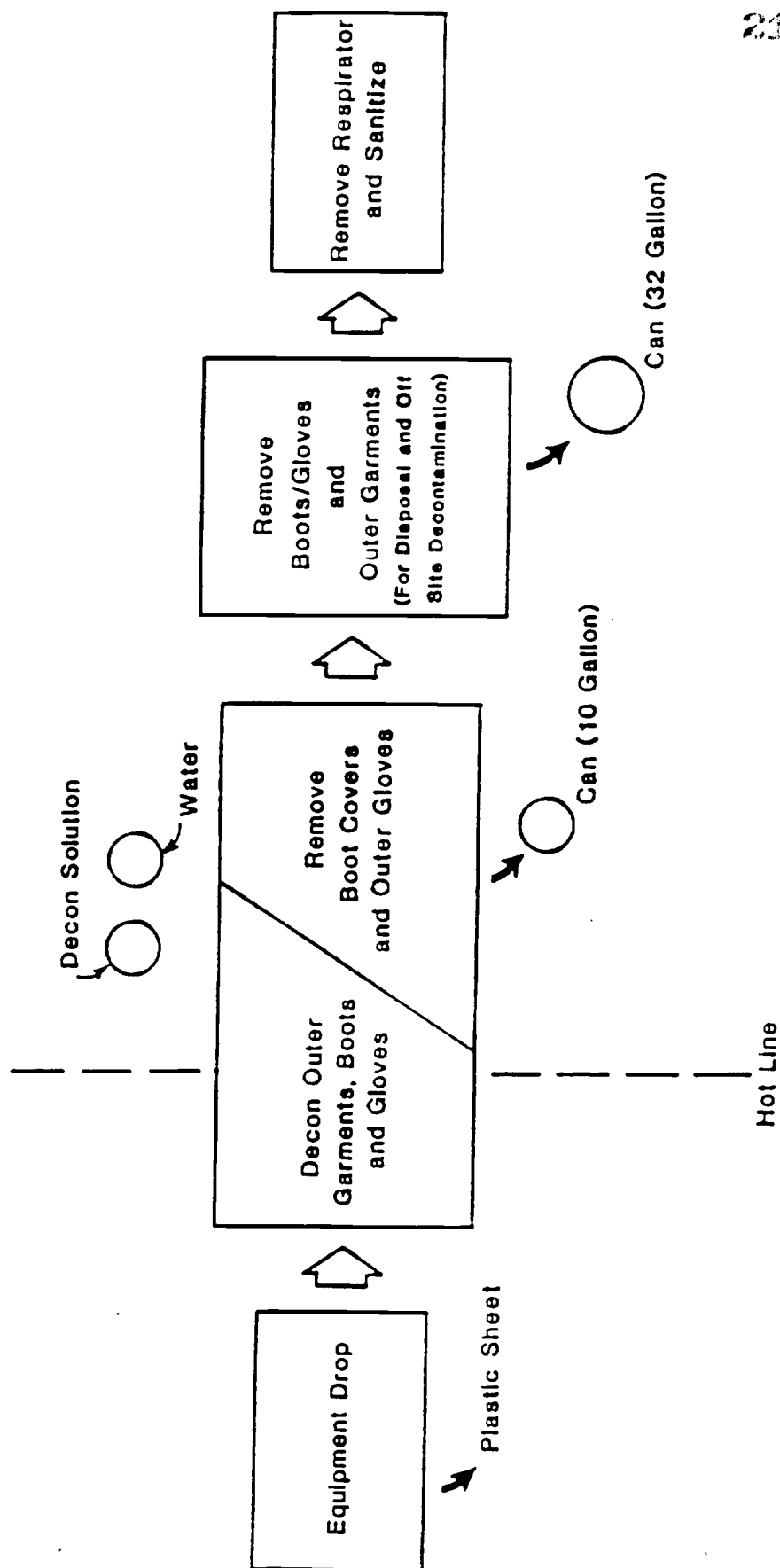
4TH REVIEW—The FOA Commander shall (to include the person designated Acting Commander in his absence) review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.

ATTACHMENT D

PERSONNEL DECONTAMINATION STATION LAYOUT

212153

Wind Direction



Minimum Layout of
Personnel Decontamination Station

ATTACHMENT E

WORK ZONE LAYOUT

212155

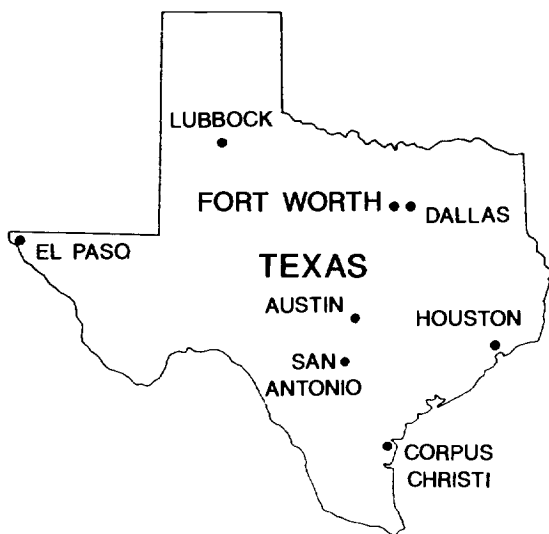
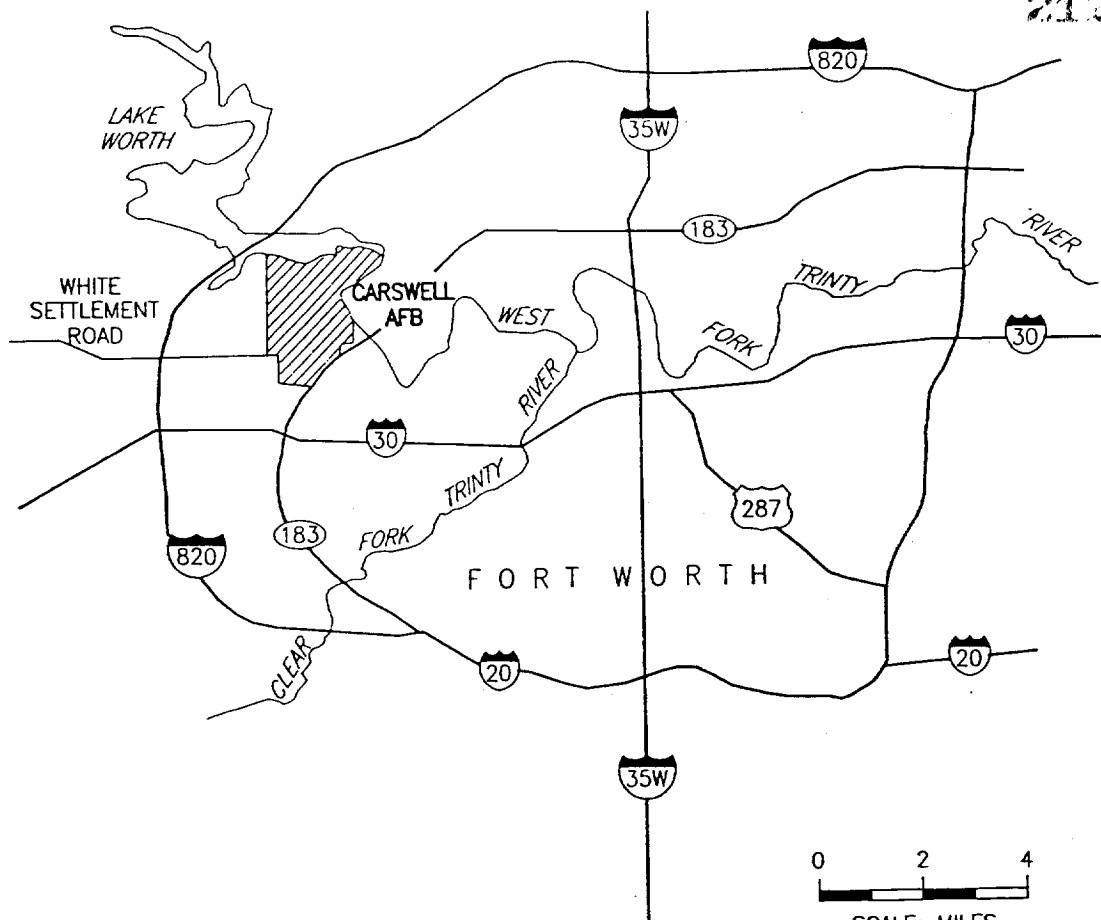
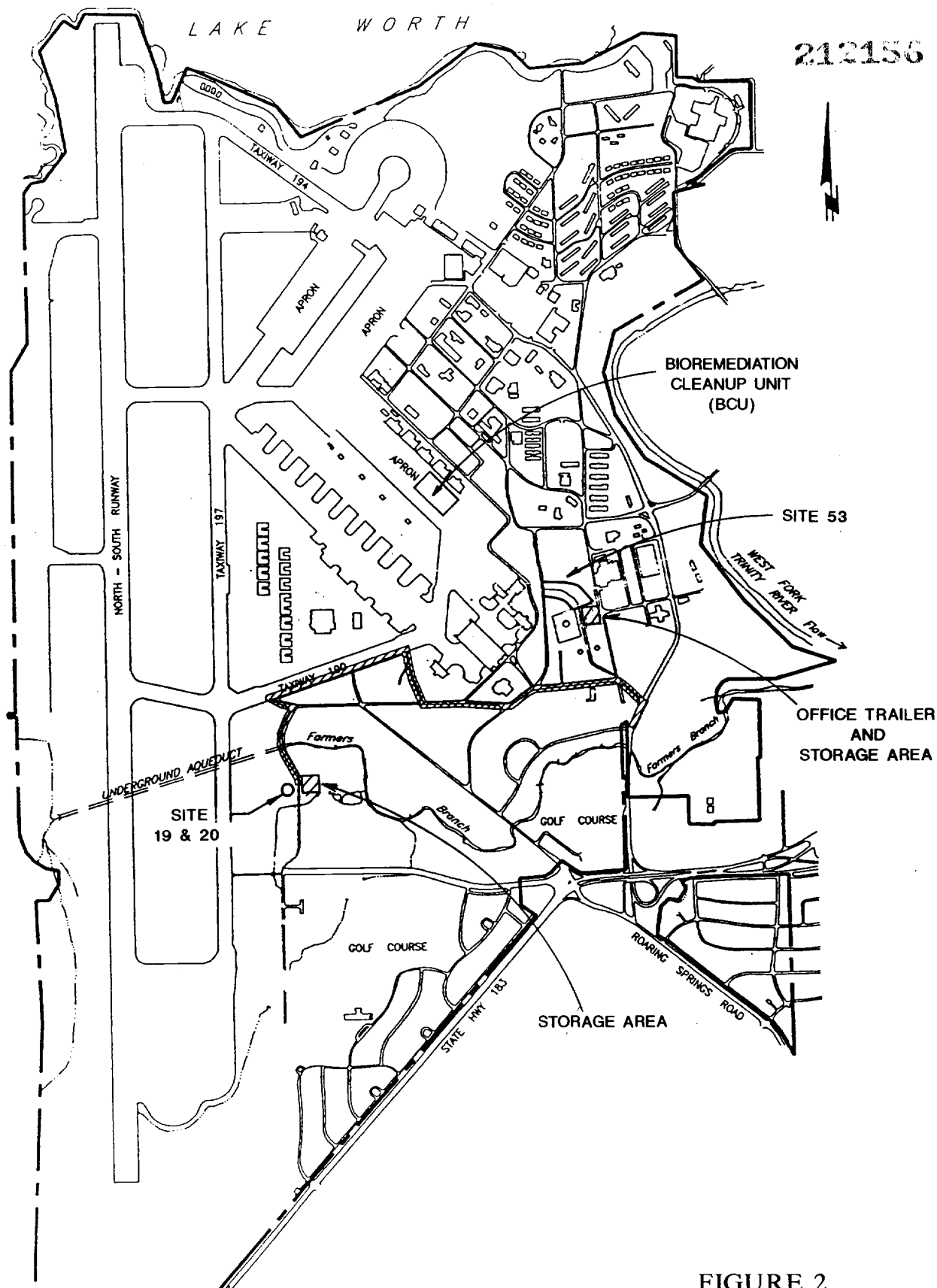


FIGURE 1
VICINITY MAP
CARSWELL AIR FORCE BASE
FORT WORTH, TEXAS

for
U.S. ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT

DAMES & MOORE

SOURCE : U.S. ARMY CORPS OF ENGINEERS
RFP FOR CARSWELL AFB



EXPLANATION

- ACCESS ROUTE TO SITE
BASE BOUNDARY

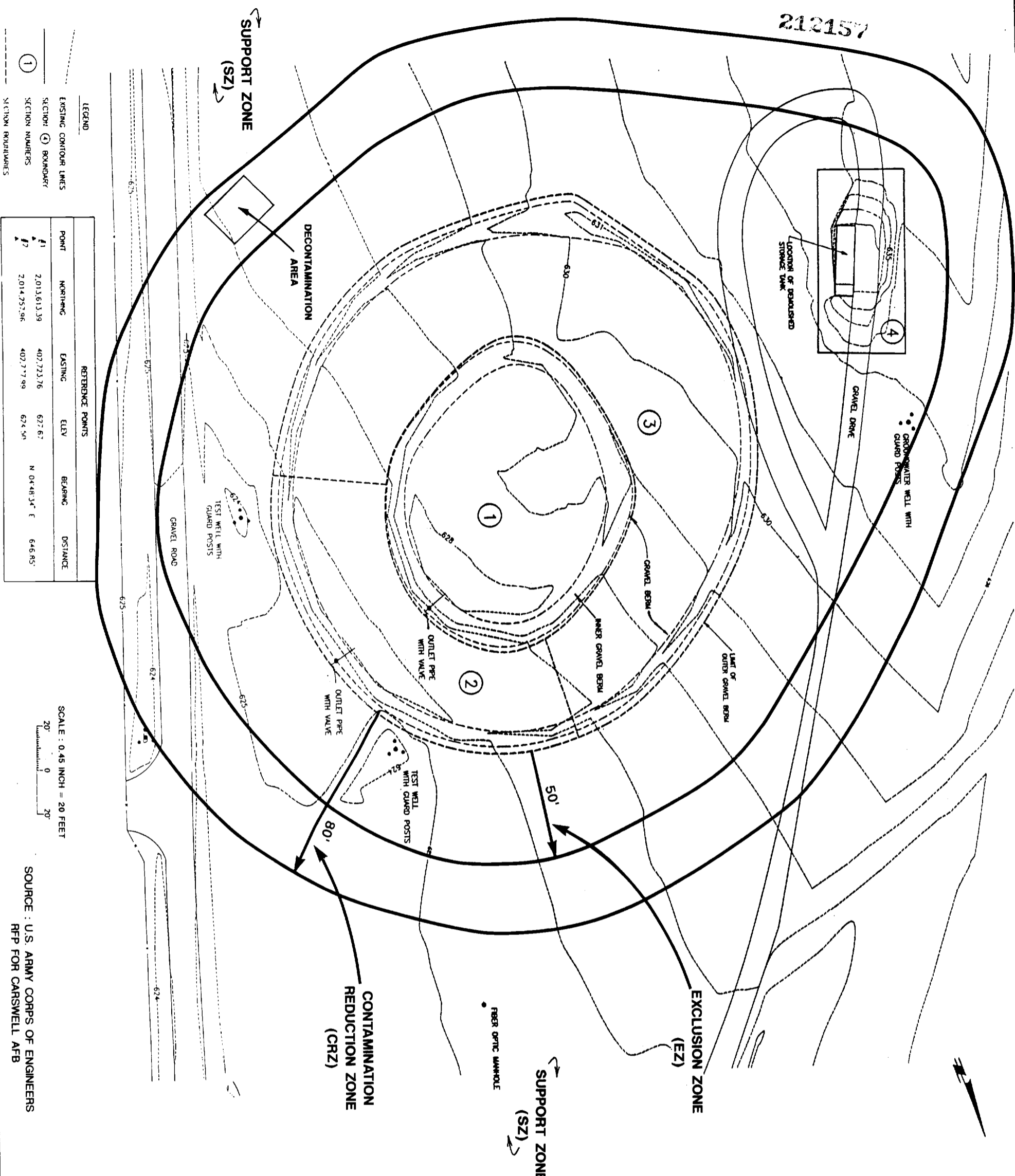
SOURCE : U.S. ARMY CORPS OF ENGINEERS
RFP FOR CARSWELL AFB

0 1000 2000
SCALE: FEET

FIGURE 2
SITE LOCATION MAP
CARSWELL AIR FORCE BASE
FORT WORTH, TEXAS

for
U.S. ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT

DAMES & MOORE



LEGEND		REFERENCE POINTS			
EXISTING CONTOUR LINES		POINT	NORTHING	EASTING	ELEV
SECTION ① BOUNDARY		1	2,013,613.39	402,723.76	627.67
SECTION ② BOUNDARY		2	2,014,757.96	402,777.99	624.50
SECTION BOUNDARIES					

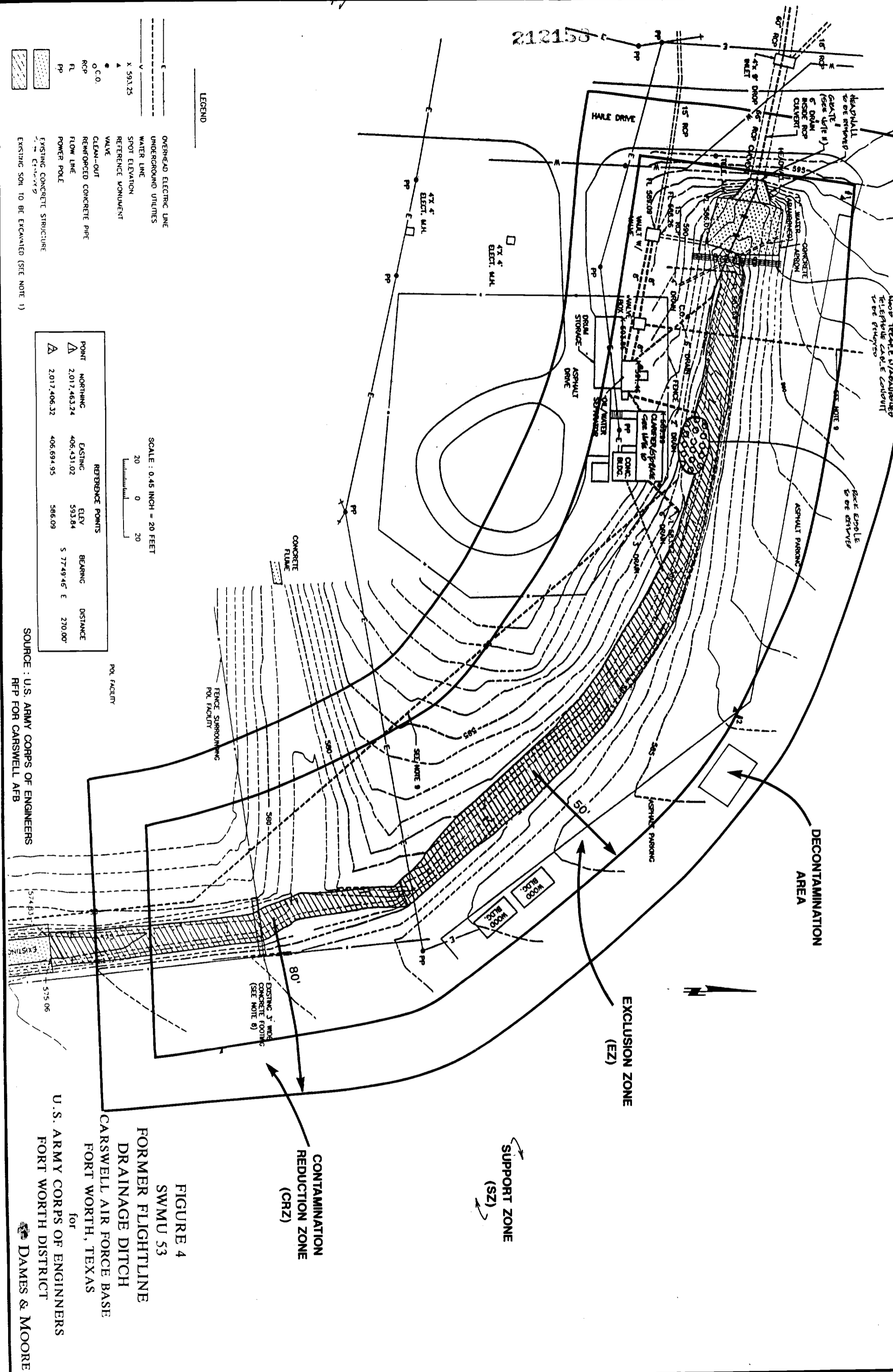
POINT	NORTHING	EASTING	ELEV	BEARING	DISTANCE
1	2,013,613.39	402,723.76	627.67	N 04°48'34" E	646.85'
2	2,014,757.96	402,777.99	624.50		

SCALE : 0.45 INCH = 20 FEET

20' 0 20'

SOURCE : U.S. ARMY CORPS OF ENGINEERS
RFP FOR CARSWELL AFB

FIGURE 3
SWMU 19 & 20
FORMER FIRE
TRAINING AREA
CARSWELL AIR FORCE BASE
FORT WORTH, TEXAS
for
U.S. ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT
DAMES & MOORE



ATTACHMENT F

SITE SAFETY BRIEFING FORM

212160

SITE SAFETY BRIEFINGS

Job Name _____ Number _____
Date _____ Start Time _____ Completed _____
Site Location _____
Type of Work (General) _____

SAFETY ISSUES

Tasks (this shift) _____

Protective Clothing/Equipment _____

Chemical Hazards _____

Physical Hazards _____

Control Methods _____

Special Equipment/Techniques _____

Nearest Phone _____
Hospital Name/Address _____
Special Topics (incidents, actions taken, etc.) _____

ATTENDEES

Print Name

Sign Name

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Meeting conducted by: _____

ATTACHMENT G

DAILY CALIBRATION LOG

HEALTH & SAFETY PROGRAM DAILY INSTRUMENT CALIBRATION CHECK SHEET

Project Name _____ Instrument _____

Job Number _____ Serial # _____

DATE	INSTRUMENT	BATTERY CHECK OK?	ZERO ADJUST OK?	CALIBRATION GAS (PPM)	READING (PPM)	CALIBRATED BY	COMMENTS

ATTACHMENT H

WORK AREA PROTECTION

WORK AREA PROTECTION GUIDANCE

CORRECT USE OF WORK AREA PROTECTION EQUIPMENT

1. High Level Warning

High Level Warning should be the first protection equipment to be placed in position. This will provide a degree of protection during positioning of the other equipment. Always start with the Advanced Warning and work back to the job site, establishing the guidance pattern and placing signs. The table below should be used only as a guide. Conditions will vary with type of operation and location.

Speed of Traffic	Distance from Work Site (High Level Warning)
25 or below*	-150 feet
35	250 feet
45	500 feet
55	750 feet
60	1500 feet
Expressway	1/2 Mile or More

* In heavily congested traffic areas, with slow moving vehicles, such as a downtown area, it may be advisable to place the high-level warning at the work area.

A good rule of thumb for placing the initial warning sign ahead of the work area is--the further the better the protection. Each situation will differ as in the case of hills and curves. Consideration should always be given, depending on the situation, for the use of Flagman.

2. Traffic Cones

Traffic cones create an excellent guidance path for the motorist when they are correctly positioned. Too many cones, cones in a soiled condition or improperly positioned cones only increase the hazard through confusion. Cones should only be used for guiding and channeling traffic. Keep them clean, visible and in good repair.

From the Advanced High Level Warning Device to the job site, cones should be positioned so as to effect a guidance path similar to that which is accomplished through striping, to direct vehicles into a Left Turn Lane. If cones are SPACED CORRECTLY with relation to speed to traffic, they will produce the same effect as a solid line to the approaching motorist.

The following table gives suggested distances for the spacing of Traffic Cones.

Miles per Hour	Distance in Feet
up to 30 mph	10 - 20 feet
30 - 45 mph	25 - 35 feet
45 - 55 mph	40 - 50 feet
55 and over	55 - 60 feet

3. Barricades

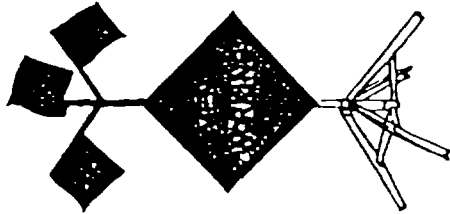
The generally accepted method is to place Barricades at right angles to the direction to the approaching traffic. They should be highly visible in themselves. There are many approved uses for Barricades and there are many variations in shapes and sizes. Refer to "Manual on Uniform Traffic Control Devices."

4. Flasher Warning Lights

The most EFFECTIVE Flasher Warning Lights are those which incorporate the following:

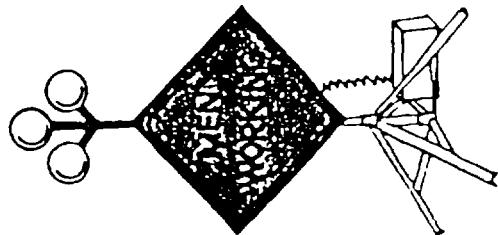
- 7" diameter lens
- Transistor circuit
- Incandescent bulb
- Percentage Dwell--22-28%
- Flash Rate (approximately 70 fpm)

HIGH LEVEL WARNING PROTECTION



Advanced "High Level Warning" for daytime use

Easily assembled, 3 red flags—with stabilizing weights and wind spilling devices—the standard will withstand high winds without turning or toppling.



Advanced "High Level Warning" for night use

Three 7" diameter flashing amber lights. Battery operated—when positioned properly flasher warning lights create an excellent warning.

TABLE A

**SUGGESTED SPACING OF HIGH LEVEL ADVANCED WARNING
RELATED TO SPEED OF TRAFFIC**

Speed of Traffic	Lane Closure	Low Level Guidance Traffic Cone Spacing	High Level Warning Sign to Work Site	Sign Legend	Sign Size
25 mph or below	No	10'	150'	Men Working	30" x 30"
35 mph	No	35'	250'	Men Working	30" x 30"
45 mph	No	45'	500'	Men Working	30" x 30"
	Yes	45'	1st Sign 500' 2nd Sign 150'	Right or Left Lane Closed Ahead Men Working	48" x 48" 30" x 30"
55 mph	No	55'	750'	Men Working	30" x 30"
	Yes	55'	1st Sign 750' 2nd Sign 150'	Right or Left Lane Closed Ahead Men Working	48" x 48" 30" x 30"
FREEWAY	No	65'	1st Sign 2500' 2nd Sign 1500' 3rd Sign 1000' 4th Sign 500' 5th Sign 150'	Men Working Men Working Men Working Men Working Men Working	48" x 48" 48" x 48" 48" x 48" 48" x 48" 30" x 30"
	Yes	65'	1st Sign 2500' + 2nd Sign 1500' 3rd Sign 1000' 4th Sign 500' 5th Sign 150'	Right or Left Lane Closed Ahead Right or Left Lane Closed Ahead Right or Left Lane Closed Ahead Right or Left Lane Closed Ahead Men Working	48" x 48" 48" x 48" 48" x 48" 48" x 48" 30" x 30"

NOTE: Freeway with median — repeat signing on median.
Lane Closure — repeat in opposite direction if guidance path affected.

ATTACHMENT I

FLAME IONIZATION DETECTOR OPERATING INSTRUCTIONS

FOXBORO OVA OPERATING INSTRUCTIONS

- A. Move the INSTR switch to ON and allow five minutes to warm up.
- B. Battery Check: Move INSTR/BATT Test Switch to the BATT position and ensure battery is charged by reading the indication on the readout meter.
- C. Move the CALIBRATE Switch to X10 and adjust the meter reading to zero with the CALIBRATE ADJUST (zero) Knob.
- D. Ensure the PUMP Switch is ON and observe the SAMPLE FLOW RATE Indicator. Indication should be approximately two units.
- E. Open H2 TANK VALVE one (1) turn and observe the reading on the H2 TANK PRESSURE Indicator. (Approximately 150 psi of pressure is needed for each hour of operation.)
- F. Open H2 SUPPLY VALVE 1/2 to 1 turn and observe the reading on the H2 SUPPLY PRESSURE Indicator.

CAUTION

Do not leave H2 SUPPLY VALVE open when the pump is not running, as this will allow hydrogen to accumulate in the detector chamber.

- G. Confirm that meter is still reading zero (readjust if required).
- H. Depress ignite button. There will be a slight "pop" as the hydrogen ignites and the meter pointer will move upscale of zero. Immediately after ignition, release the igniter button. Do not depress igniter button for more than six seconds. If burner does not ignite, let instrument run for several minutes and try again. After ignition, the meter pointer will indicate the background concentration. This background level is nulled out using the CALIBRATE ADJUST (zero) Knob.
- I. Move instrument to an area which is representative of the "lowest ambient background concentration" (cleanest air) to be surveyed. Move the CALIBRATE Switch to X1 and adjust the meter to read 1 ppm with the CALIBRATE ADJUST (zero) Knob.

FOXBORO OVA FIELD CALIBRATION PROCEDURE

1. Start up OVA according to factory procedure; warm it up for ten minutes prior to calibration.
2. Fill a small (2 liter) Tedlar bag with 100 ppm Methane/balance air calibration gas.
3. Set the calibrate switch to X10.
4. Sample the gas from the Tedlar bag. Use the "gas select" potentiometer to adjust the reading on the readout scale to near 100 (10 x 10). The reading should stabilize in 20 to 30 seconds.
5. Lock the knob on the gas select potentiometer; the OVA is now ready to use.

SHUTDOWN PROCEDURE

The following procedure should be followed for shutdown of the instrument:

1. Close H2 SUPPLY VALVE.
2. Close H2 TANK VALVE.
3. Move the INSTR Switch to OFF.
4. Wait five seconds and move PUMP Switch to OFF. INSTRUMENT IS NOW IN A SHUTDOWN CONFIGURATION.

FOXBORO.HSP

ATTACHMENT J

MATERIAL SAFETY DATA SHEETS



Genium Publishing Corporation

1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 470
Diesel Fuel Oil No. 2-D

212170

Issued: 10/81

Revision: A, 11/90

Section 1. Material Identification

33

Diesel Fuel Oil No. 2-D Description: Diesel fuel is obtained from the middle distillate in petroleum separation; a distillate oil of low sulfur content. It is composed chiefly of unbranched paraffins. Diesel fuel is available in various grades, one of which is synonymous with fuel oil No. 2-D. This diesel fuel oil requires a minimum Cetane No. (efficiency rating for diesel fuel comparable to octane number ratings for gasoline) of 40 (ASTM D613). Used as a fuel for trucks, ships, and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.

Other Designations: CAS No. 68334-30-5, diesel fuel.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*⁽⁷⁾ for a suppliers list.

Cautions: Diesel fuel oil No. 2-D is a skin irritant and central nervous depressant with high mist concentrations. It is an environmental hazard and moderate fire risk.



HMIS

H 0

F 2

R 0

PPG*

* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Diesel fuel oil No. 2-D*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data†
None established	Mineral Oil Mist TWA: 5 mg/m ³ † STEL: 10 mg/m ³	None established	Rat, oral, LD ₅₀ : 9 g/kg produces gastrointestinal (hypermotility, diarrhea) effects

* Diesel fuel No. 2-D tends to be low in aromatics and high in paraffinics. This fuel oil is complex mixture of: 1) >95% paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, 2) sulfur (<0.5%), and 3) benzene (<100 ppm). (A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)). Although low in the fuel itself, benzene concentrations are likely to be much higher in processing areas.

† As sampled by nonvapor-collecting method.

‡ Monitor NIOSH, RTECS (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point Range: 340 to 675 °F (171 to 358 °C)

Specific Gravity: <0.86

Viscosity: 1.9 to 4.1 centistoke at 104 °F (40 °C)

Water Solubility: Insoluble

Appearance and Odor: Brown, slightly viscous liquid.

Section 4. Fire and Explosion Data

Flash Point: 125 °F (52 °C) min. **Autoignition Temperature:** >500 °F (932 °C) **LEL:** 0.6% v/v **UEL:** 7.5% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or foam to fight fire. Use a water spray to cool fire exposed containers. Do not use a forced water spray directly on burning oil since this will scatter the fire. Use a smothering technique for extinguishing fire.

Unusual Fire or Explosion Hazards: Diesel fuel oil No. 2-D is a OSHA Class II combustible liquid. Its volatility is similar to that of gas oil. Vapors may travel to a source of ignition and flash back.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to pollution and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Diesel fuel oil No. 2-D is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: It is incompatible with strong oxidizing agents; heating greatly increases the fire hazard.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of diesel fuel oil No. 2-D can produce various hydrocarbons and hydrocarbon derivatives, and other partial oxidation products such as carbon dioxide, carbon monoxide, and sulfur dioxide.

Section 6. Health Hazard Data

Carcinogenicity: Although the IARC has not assigned an overall evaluation to diesel fuels as a group, it has evaluated occupational exposures in petroleum refining as an IARC probable human carcinogen (Group 2A). It has evaluated distillate (light) diesel oils as not classifiable as human carcinogens (Group 3).

Summary of Risks: Although diesel fuel's toxicologic effects should resemble kerosene's, they are somewhat more pronounced due to additives such as sulfurized esters. Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, vomiting, and loss of coordination, depending on concentration and exposure time. When removed from exposure area, affected persons usually recover completely. If vomiting occurs after ingestion and if oil is aspirated into the lungs, hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result. A comparative ratio of oral to aspirated lethal doses may be 1 pt vs. 5 ml. Aspiration may also result in transient CNS depression or excitement. Secondary effects may include hypoxia (insufficient oxygen in body cells), infection, pneumatocele formation, and chronic lung dysfunction. Inhalation may result in euphoria, cardiac dysrhythmias, respiratory arrest, and CNS toxicity.

Prolonged or repeated skin contact may irritate hair follicles and block sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Central nervous system, skin, and mucous membranes.

Primary Entry Routes: Inhalation, ingestion.

Acute Effects: Systemic effects from ingestion include gastrointestinal irritation, vomiting, diarrhea, and in severe cases central nervous system depression, progressing to coma or death. Inhalation of aerosols or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish discoloration of the skin and mucous membranes caused by deficient blood oxygenation).

Chronic Effects: Repeated contact with the skin causes dermatitis.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body have been exposed or if irritation persists, get medical help immediately. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard.

Contact a physician immediately. Position to avoid aspiration.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards.

Use a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Diesel fuel oil No. 2-D spills may be environmental hazards. Report large spills.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

OPA Designations

CRA Hazardous Waste (40 CFR 261.21): Ignitable waste

ERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with a mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. **Warning!** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.⁽¹⁰³⁾

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for a OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in storage or use areas.

Engineering Controls: Avoid vapor or mist inhalation and prolonged skin contact. Wear protective rubber gloves and chemical safety glasses where contact with liquid or high mist concentration may occur. Additional suitable protective clothing may be required depending on working conditions. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. At least weekly laundering of work clothes is recommended. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)

OT Shipping Name: Fuel oil

OT Hazard Class: Combustible liquid

ID No.: NA1993

DOT Label: None

OT Packaging Exceptions: 173.118a

OT Packaging Requirements: None

MSDS Collection References: 1, 6, 7, 12, 73, 84, 101, 103, 126, 127, 132, 133, 136, 143, 146

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD; **Edited by:** JR Stuart, MS


Genium Publishing Corporation

1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 467
Automotive Gasoline, Lead-free

Issued: 10/81

Revision: A, 9/91

Section 1. Material Identification

Automotive Gasoline, Lead-free, Description: A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.

Other Designations: CAS No. 8006-61-9, benzim, gasoline, gasolene, motor spirits, natural gasoline, petrol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*TM for a suppliers list.

R 1
I 2
S 2*
K 4
* Skin absorption

NFPA



HMIS

H 2

F 3

R 1

PPG†

† Sec. 8

35

Cautions: Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

1990 OSHA PELs

8-hr TWA: 300 ppm, 900 mg/m³

15-min STEL: 500 ppm, 1500 mg/m³

1990-91 ACGIH TLVs

TWA: 300 ppm, 890 mg/m³

STEL: 500 ppm, 1480 mg/m³

1990 NIOSH REL

None established

1985-86 Toxicity Data*

Man, inhalation, TC₅₀: 900 ppm/1 hr; toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)

Human, eye: 140 ppm/8 hr; toxic effects include mild irritation

Rat, inhalation, LC₅₀: 300 g/m³/5 min

* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.

† See NIOSH, RTECS (LX3300000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)

Vapor Density (air = 1): 3.0 to 4.0

Density/Specific Gravity: 0.72 to 0.76 at 60 °F (15.6 °C)

Water Solubility: Insoluble

Appearance and Odor: A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

Section 4. Fire and Explosion Data

Flash Point: -45 °F (-43 °C)

Autoignition Temperature: 536 to 853 °F (280 to 456 °C)

LEL: 1.3% v/v

UEL: 6.0% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.

Unusual Fire or Explosion Hazards: Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Automotive gasoline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).

Summary of Risks: Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonitis. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Skin, eye, respiratory and central nervous systems.

Primary Entry Routes: Inhalation, ingestion, skin contact.

Acute Effects: Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonitis. Other symptoms following acute exposure include acute hemorrhage of the pancreas, fatty degeneration of the liver and kidneys, and passive congestion of spleen.

Chronic Effects: Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard.

Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).

Aquatic Toxicity: Bluegill, freshwater, LC₅₀ 8 ppm/96 hr.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. Note: Resistance of specific materials can vary from product to product.

Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.⁽¹⁰⁾

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.

Engineering Controls: Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear clean work clothing daily.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Gasoline (including casing-head and natural)

DOT Hazard Class: Flammable liquid

ID No.: UN1203

DOT Label: Flammable liquid

DOT Packaging Exceptions: 173.118

DOT Packaging Requirements: 173.119

IMO Shipping Name: Gasoline

IMO Hazard Class: 3.1

ID No.: UN1203

IMO Label: Flammable liquid

IMDG Packaging Group: II

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159

Prepared by: M Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD; Edited by: JR Stuart, MS

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 43

TRISODIUM PHOSPHATE
DODECAHYDPATE

Date November 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: TRISODIUM PHOSPHATE DODECAHYDRATE

DESCRIPTION: Crystallizes from water as $\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$ and can exist as several hydrate forms, depending on processing, and as the anhydrous salt.

OTHER DESIGNATIONS: TSP, Trisodium Orthophosphate, Sodium Phosphate, Tribasic, Tertiary Sodium Phosphate, GE Material D4K1, ASTM D538, CAS# 007 601 549

MANUFACTURER: Available from several suppliers, including FMC Corporation, Monsanto Co., Stauffer Chemical Co., and Olin Corp.

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Trisodium Phosphate (as $\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$)	> 97	No TLV established*
*Under OSHA inert dust limits it can be assumed that airborne particulate, not otherwise controlled, is limited to a maximum of 5 mg/kg of respirable dust; however, this level may not be adequate to prevent irritation with this material.		($\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$) Rat, Oral LD ₅₀ 7400 mg/kg

SECTION III. PHYSICAL DATA

Boiling point -----	-11 H_2O at 100 C (decomposes) -	Specific gravity (20/4 C) -----	1.62
Melting point, deg C --	> 73.3 (dec)	pH of 1% water solution at 25 C -	ca 12
Solubility, g/100g H_2O :		Molecular weight -----	380.1
at 0 C -----	1.5	Appearance & Odor: White or colorless crystalline solid (also as powder flake, granules, etc.). No odor.	
at 15 C -----	28.3		
at 70 C -----	157		

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None	None	None		
Extinguishing Media: Use that which is appropriate to the surrounding fire; this material is non-combustible.				
In a fire situation at high temperature phosphates can emit highly toxic phosphorus oxide fumes. Firefighters should use self-contained breathing apparatus.				

SECTION V. REACTIVITY DATA

This material is a stable alkaline solid at room temperature. It does not undergo hazardous polymerization.

It is incompatible with acidic materials.

SECTION VI. HEALTH HAZARD INFORMATION

TLV None established (See Sect II)

This alkaline material will cause irritation to the respiratory tract if inhaled as a dust or as a solution mist. Prolonged or repeated skin contact will irritate the skin. Eye contact will irritate and can damage the eyes (alkaline attack). This material is low in toxicity by ingestion, but its alkaline nature will irritate, injure the digestive tract. (Trisodium phosphate is used as a food additive; but it must be reduced in alkalinity before being taken into the body.)

FIRST AID:

Eye contact: Promptly flush with plenty of water for 15 minutes. Get medical help.

Skin contact: Wash well with soap and water; rinse well with water. If irritation persists, get medical help.

Inhalation: Remove to fresh air. Get medical help if irritation persists.

Ingestion: Give 1-2 glasses of water or milk to drink to dilute; then give fruit juice or diluted vinegar to drink. Do not induce vomiting! Immediately contact a physician.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

For large spills, notify safety personnel. Clean-up personnel should use protection against contact or inhalation of dust or mist. Scoop up spill for recovery or disposal and place in a container with a lid. Flush residues to the sewer with plenty of water.

DISPOSAL: Scrap material can be used for neutralizing acidic wastes, or it can be buried in an approved manner in an approved landfill. Small amounts can be flushed to the sewer if regulations permit. Follow Federal, State and local regulations for disposal.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general ventilation to the workplace; if dusting conditions occur, local exhaust ventilation will be needed and a NIOSH approved dust respirator may be required.

The use of rubber or plastic gloves and chemical safety glasses with side shields is recommended for handling this material. An apron may also be desirable to prevent contact with clothing, especially where solutions are involved.

Provide eyewash station near to the workplace where this material is used; a safety shower may also be needed where large amounts of solution are prepared or used.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store this material in tightly sealed containers in a clean, dry, ventilated area. Prevent physical damage to containers.

Avoid contact with the body and inhalation of dust.

Note that anhydrous trisodium phosphate and lower hydrates are more alkaline on a weight basis than $\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$.

DATA SOURCE(S) CODE: 1,2,4-7,12,15

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APPROVALS: MIS, CRD

Industrial Hygiene and Safety

Corporate Medical Staff

GENIUM PUBLISHING

ATTACHMENT K

FEDERAL OSHA TRENCHING AND EXCAVATION REGULATIONS

ers). Such system is designed, specifically to support the sidewalls of an excavation and prevent cave-ins.

Bell-bottom pier hole means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

Benching (Benching system) means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Competent person means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Cross braces mean the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

Excavation means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Faces or *sides* means the vertical or inclined earth surfaces formed as a result of excavation work.

Failure means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Hazardous atmosphere means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

Kickout means the accidental release or failure of a cross brace.

Protective system means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

Ramp means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

Registered Professional Engineer means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional

engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

Sheeting means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield (Shield system) means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with §1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

Shoring (Shoring system) means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sides. See "Faces."

Sloping (Sloping system) means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Stable rock means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Structural ramp means a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

Support system means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Tabulated data means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

Trench (Trench excavation) means a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6m) or less (measured at the bottom of

Subpart P—Excavations

Authority: Sec. 107, Contract Worker Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736), as applicable, and 29 CFR part 1911.
[Subpart P authority citation added by 54 FR 45959, October 31, 1989]

§1926.650 Scope, application, and definitions applicable to this subpart.

(a) *Scope and application.* This subpart applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

(b) *Definitions applicable to this subpart.*

Accepted engineering practices means those requirements which are compatible with standards of practice required by a registered professional engineer.

Aluminum Hydraulic Shoring means a pre-engineered shoring system comprised of aluminum hydraulic cylinders (cross-braces) used in conjunction with vertical rails (uprights) or horizontal rails (wal-

the excavation), the excavation is also considered to be a trench.

Trench box. See "Shield."

Trench shield. See "Shield."

Uprights means the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "sheeting."

Wales means horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

§1926.651 General requirements.

(a) *Surface encumbrances.* All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

(b) *Underground installations.* (1) The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

(2) Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

(3) When excavation operations approach the estimated location of underground installations the exact location of the installations shall be determined by safe and acceptable means.

(4) While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

(c) *Access and egress.* (i) *Structural ramps.* (1) Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

(ii) Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.

(iii) Structural members used for ramps and runways shall be of uniform thickness.

(iv) Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

(v) Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

(2) *Means of egress from trench excavations.* A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

(d) *Exposure to vehicular traffic.* Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

(e) *Exposure to falling loads.* No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with §1926.601(b)(6), to provide adequate protection for the operator during loading and unloading operations.

(f) *Warning system for mobile equipment.* When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

(g) *Hazardous atmospheres.* (1) *Testing and controls.* In addition to the requirements set forth in subparts D and E of this part (29 CFR 1926.50 - 1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

(i) Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

(ii) Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres.

These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

(iii) Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

(iv) When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

(2) *Emergency rescue equipment.* (i) Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

(ii) Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a life-line securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

(h) *Protection from hazards associated with water accumulation.* (1) Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

(2) If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

(3) If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

(i) *Stability of adjacent structures.* (1) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations support

systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

(2) Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

(i) A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

(ii) The excavation is in stable rock; or

(iii) A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or

(iv) A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

(3) Sidewalks, pavements, and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

(j) *Protection of employees from loose rock or soil.* (1) Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of sealing to remove loose material; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection.

(2) Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (61 cm) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

(k) *Inspections.* (1) Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

(2) Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions,

exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

(1) *Fall protection.* (1) Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.

(2) Adequate barrier physical protection shall be provided at all remotely located excavations. All wells, pits, shafts, etc., shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc., shall be backfilled.

§1926.652 Requirements for protective systems.

(a) *Protection of employees in excavations.* (1) Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:

(i) Excavations are made entirely in stable rock; or

(ii) Excavations are less than 5 feet (1.52 m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

(2) Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

(b) *Design of sloping and benching systems.* The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (b)(1); or, in the alternative, paragraph (b)(2); or, in the alternative, paragraph (b)(3); or, in the alternative, paragraph (b)(4), as follows:

(1) *Option (1)—Allowable configurations and slopes.* (i) Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

(ii) Slopes specified in paragraph (b)(1)(i) of this section, shall be excavated to form configurations that are in accordance with the slopes shown for Type C soil in Appendix B to this subpart.

(2) *Option (2)—Determination of slopes and configurations using Appendices A and B.* Maximum allowable slopes, and allowable configurations for sloping and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendices A and B to this subpart.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of sloping or benching systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data shall be in written form and shall include all of the following:

(A) Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;

(B) Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) under paragraph (b) of this section shall be approved by a registered professional engineer.

(ii) Designs shall be in written form and shall include at least the following:

(A) The magnitude of the slopes that were determined to be safe for the particular project;

(B) The configurations that were determined to be safe for the particular project; and

(C) The identity of the registered professional engineer approving the design.

(iii) At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time the design need not be at the jobsite, but a copy shall be made available to the Secretary upon request.

(c) *Design of support systems, shield systems, and other protective systems.* Designs of support systems, shield systems, and other protective systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (c)(1); or, in the alternative, paragraph (c)(2); or, in the alternative, paragraph (c)(3); or, in the alternative, paragraph (c)(4) as follows:

(1) *Option (1)—Designs using appendices A, C, and D.* Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in appendices A and C to this subpart. Designs for aluminum hydraulic shoring shall be in accordance with paragraph (c)(2) of this section, but if manufacturer's tabulated data cannot be utilized, designs shall be in accordance with appendix D.

(2) *Option (2)—Designs Using Manufacturer's Tabulated Data.* (i) Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in

accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

(ii) Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall only be allowed after the manufacturer issues specific written approval.

(ii) Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations shall be in written form at the jobsite during construction of the protective system. After that time this data may be stored off the jobsite, but a copy shall be made available to the Secretary upon request.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of support systems, shield systems, or other protective systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data shall be in written form and include all of the following:

(A) Identification of the parameters that affect the selection of a protective system drawn from such data;

(B) Identification of the limits of use of the data;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, shall be approved by a registered professional engineer.

(ii) Designs shall be in written form and shall include the following:

(A) A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and

(B) The identity of the registered professional engineer approving the design.

(iii) At least one copy of the design shall be maintained at the jobsite during construction of the protective system. After that time, the design may be stored off the jobsite, but a copy of the design shall be made available to the Secretary upon request.

(d) *Materials and equipment.* (1) Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function.

(2) Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

(3) When material or equipment that is used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

(e) *Installation and removal of support—(1) General.* (i) Members of support systems shall be securely connected together to prevent sliding, falling, kick-outs, or other predictable failure.

(ii) Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

(iii) Individual members of support systems shall not be subjected to loads exceeding those which those members were designed to withstand.

(iv) Before temporary removal of individual members begins, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

(v) Removal shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

(vi) Backfilling shall progress together with the removal of support systems from excavations.

(2) *Additional requirements for support systems for trench excavations.* (i) Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

(ii) Installation of a support system shall be closely coordinated with the excavation of trenches.

(f) *Sloping and benching systems.* Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of

falling, rolling, or sliding material or equipment.

(g) *Shield systems—(1) General.* (i) Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

(ii) Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(iii) Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

(iv) Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

(2) *Additional requirement for shield systems used in trench excavations.* Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

Appendix A to Subpart P

Soil Classification

(a) *Scope and application—(1) Scope.* This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

(2) *Application.* This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in §1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic shoring is designed in accordance with appendix D. This Appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in §1926.652(c), and the use of the data is predicated on the use of the soil classification system set forth in this appendix.

(b) *Definitions.* The definitions and examples given below are based on, in whole or in part, the following: American Society for Testing Materials (ASTM) Standards D653-85 and D2488; The Unified Soils Classification System; The U.S. Department of Agriculture (USDA) Textural Classification Scheme; and The National Bureau of Standards Report BSS-121.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-sized sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Dry soil means soil that does not exhibit visible signs of moisture content.

Fissured means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt, (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or shear vane.

Soil classification system means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure.

Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Submerged soil means soil which is underwater or is free seeping.

Type A means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

- (i) The soil is fissured; or
- (ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
- (iii) The soil has been previously disturbed; or
- (iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

(v) The material is subject to other factors that would require it to be classified as a less stable material.

Type B means:

- (i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or
- (ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt silt loam, sandy loam and, in some cases silty clay loam and sandy clay loam.

(iii) Previously disturbed soils except those which would otherwise be classed as Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

(v) Dry rock that is not stable; or

(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C means:

- (i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or
- (ii) Granular soils including gravel, sand, and loamy sand, or
- (iii) Submerged soil or soil from which water is freely seeping; or
- (iv) Submerged rock that is not stable, or
- (v) Material in a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or steeper.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) **Requirements**—(1) **Classification of soil and rock deposits.** Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in paragraph (b) of this appendix.

(2) **Basis of classification.** The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

(3) **Visual and manual analyses.** The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors,

and conditions affecting the classification of the deposits.

(4) **Layered systems.** In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

(5) **Reclassification.** If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

(d) **Acceptable visual and manual tests**—(1) **Visual tests.** Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

(i) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

(ii) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

(iii) Observe the side of the open excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

(iv) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

(v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

(vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

(vii) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

(2) **Manual tests.** Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

(i) **Plasticity.** Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/2-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of 1/2-inch thread can be held on one end without tearing, the soil is cohesive.

(ii) **Dry strength.** If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it

is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

(iii) *Thumb penetration.* The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. (This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2488 — "Standard Recommended Practice for Description of Soils (Visual—Manual Procedure).") Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) *Other strength tests.* Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane.

(v) *Drying test.* The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are indicated.

(B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as an unfissured cohesive material and the unconfined compressive strength should be determined.

(C) If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

Appendix B to Subpart P

Sloping and Benching

(a) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and bench-

ing protective systems is to be performed in accordance with the requirements set forth in §1926.652(b)(2).

(b) *Definitions.*

Actual slope means the slope to which an excavation face is excavated.

Distress means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and raveling, i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V).

Short term exposure means a period of time less than or equal to 24 hours that an excavation is open.

(c) *Requirements—(1) Soil classification.* Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(2) *Maximum allowable slope.* The maximum allowable slope for a soil or rock deposit shall be determined from Table B-1 of this appendix.

Table B-1
Maximum Allowable Slopes

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V) [1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [3]
STABLE ROCK	VERTICAL (90°)
TYPE A [2]	3/4:1 (53°)
TYPE B	1:1 (45°)
TYPE C	1 1/2:1 (34°)

NOTES:

- Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
- A short-term maximum allowable slope of 1 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°).
- Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

(3) *Actual slope.* (i) The actual slope shall not be steeper than the maximum allowable slope.

(ii) The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least 1/2 horizontal to

one vertical (1:2H:1V) less steep than the maximum allowable slope.

(iii) When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the max-

imum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with §1926.651(i).

(4) *Configurations.* Configurations of sloping and benching systems shall be in accordance with Figure B-1.

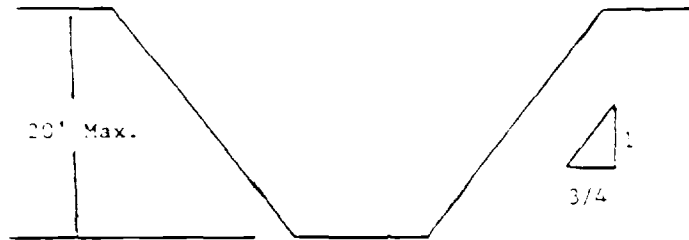
Figure B-1

Slope Configurations

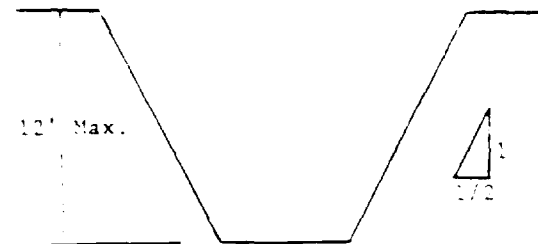
(All slopes stated below are in the horizontal to vertical ratio)

B-1.1 Excavations made in Type A soil.

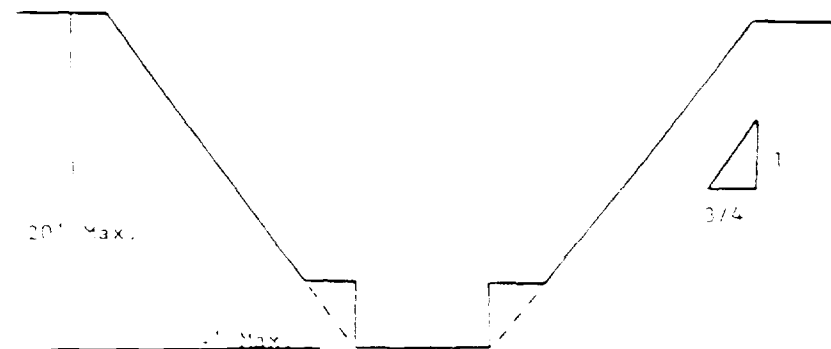
1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of $3/4:1$.

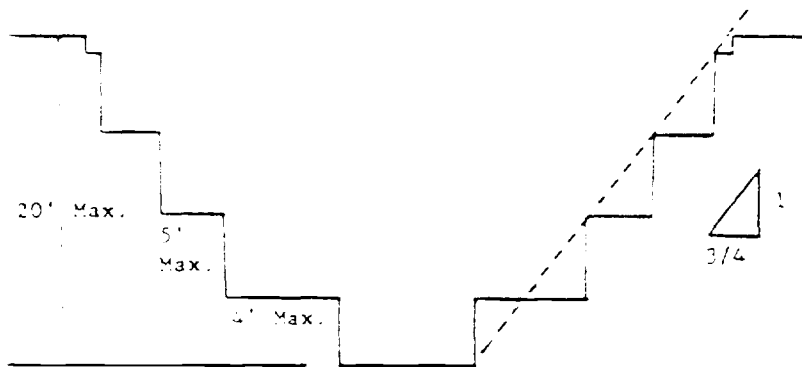
**Simple Slope—General**

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of $1/2:1$.

**Simple Slope—Short Term**

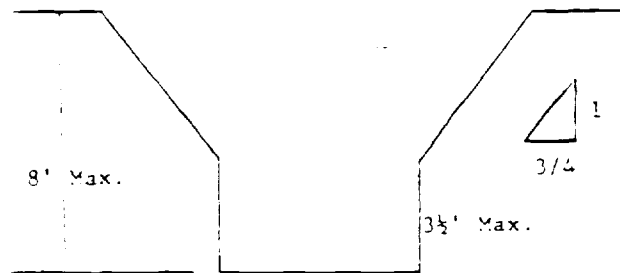
2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of $3/4$ to 1 and maximum bench dimensions as follows:

**Simple Bench**



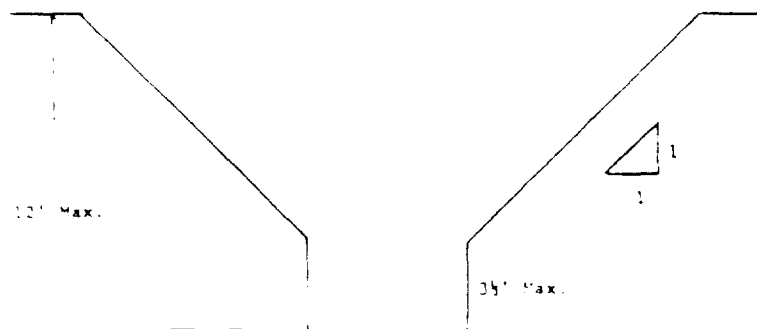
Multiple Bench

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of $3\frac{1}{2}$ feet.



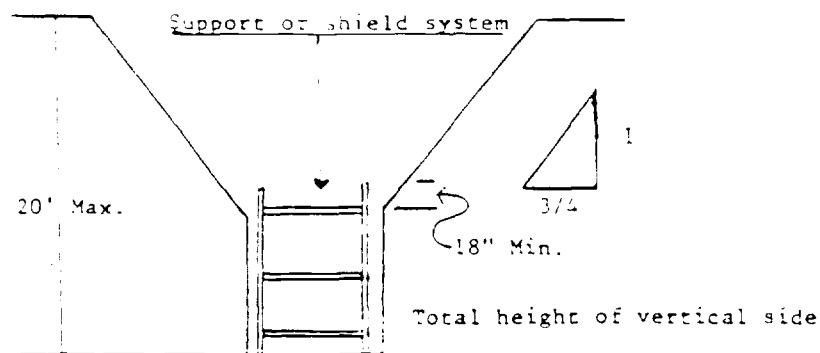
Unsupported Vertically Sided Lower Portion—Maximum 8 Feet in Depth

All excavations more than 8 feet but not more than 12 feet in depth which unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of $3\frac{1}{2}$ feet.



Unsupported Vertically Sided Lower Portion—Maximum 12 Feet in Depth

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of $3/4:1$. The support or shield system must extend at least 18 inches above the top of the vertical side.

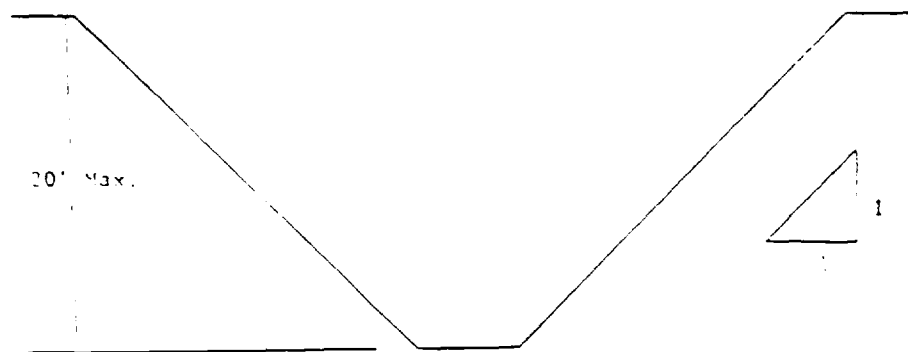


Supported or Shielded Vertically Sided Lower Portion

4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under §1926.652(b).

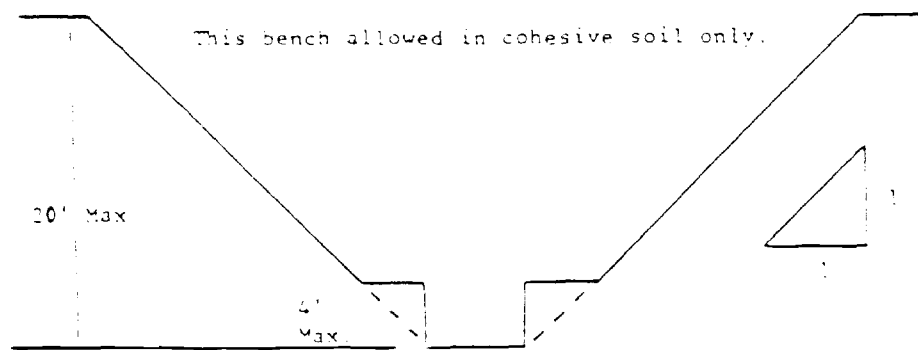
B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.

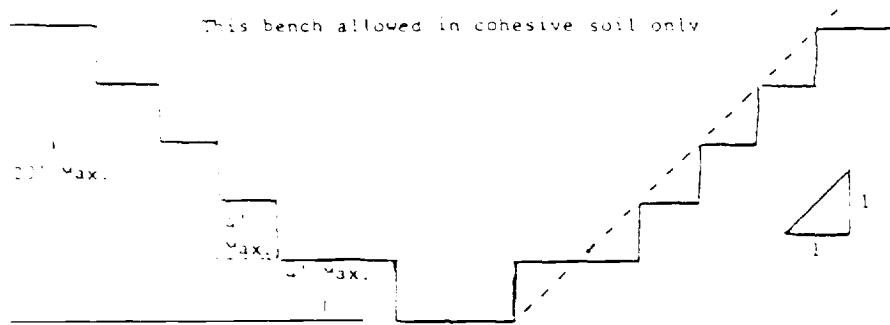


Simple Slope

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

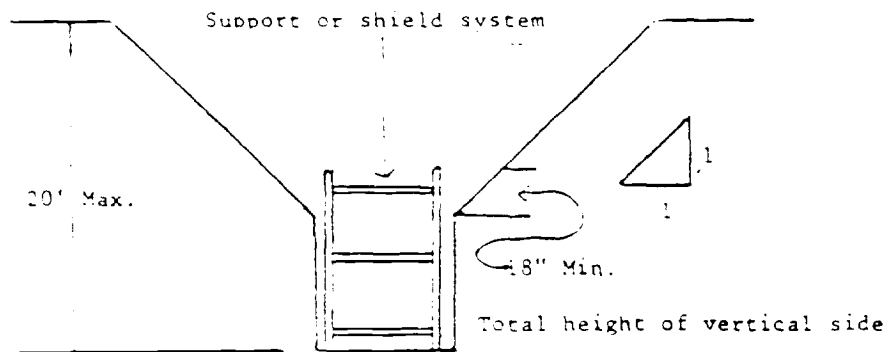


Single Bench



Multiple Bench

All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.

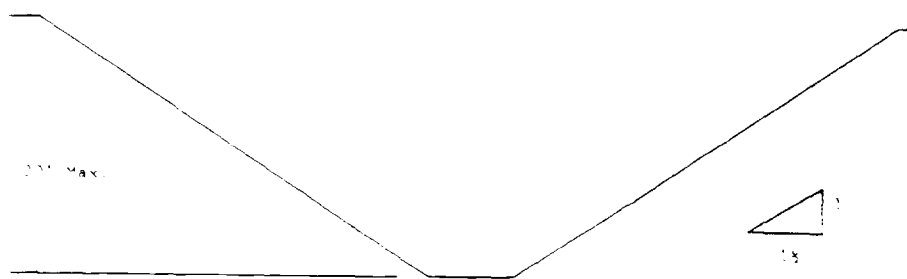


Vertically Sided Lower Portion

All other sloped excavations shall be in accordance with the other options permitted §1926.652(b).

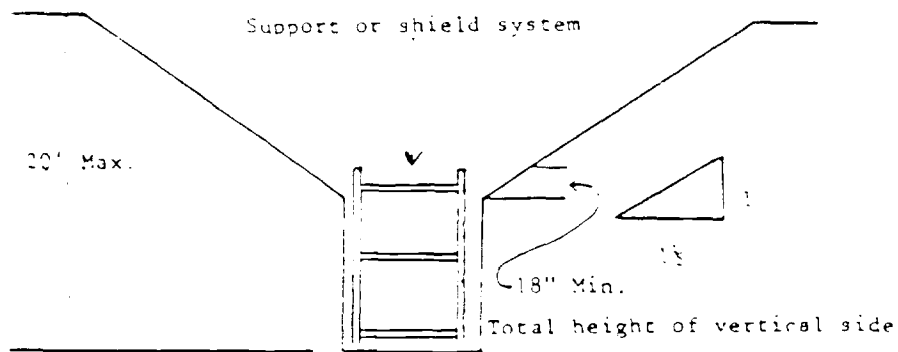
B-1.3 Excavations Made in Type C Soil

All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1 1/2:1.



Simple Slope

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1 1/2:1.

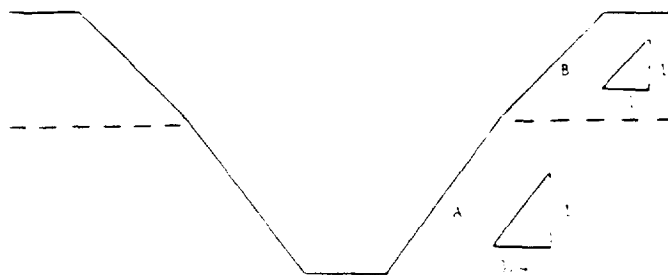


Vertical Sided Lower Portion

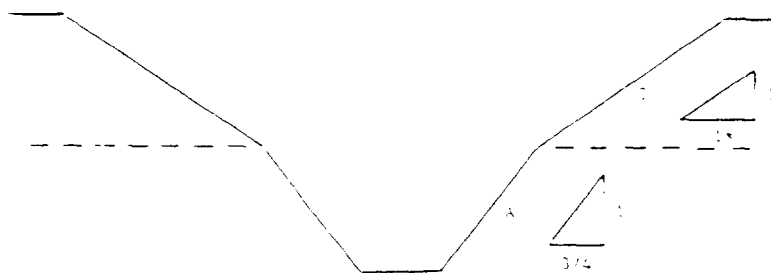
3. All other sloped excavations shall be in accordance with the other options permitted in §1926.652(b).

B-1.4 Excavations Made in Layered Soils

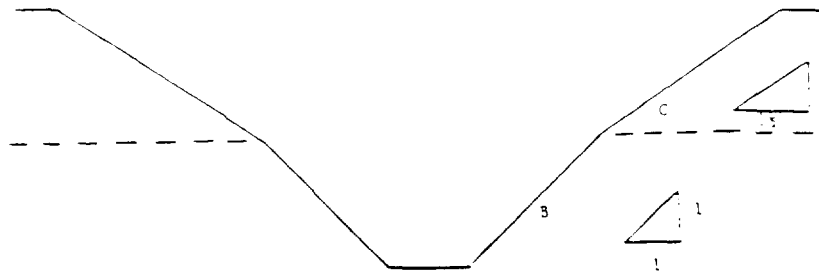
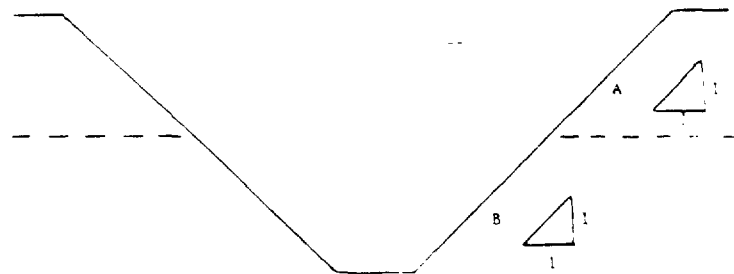
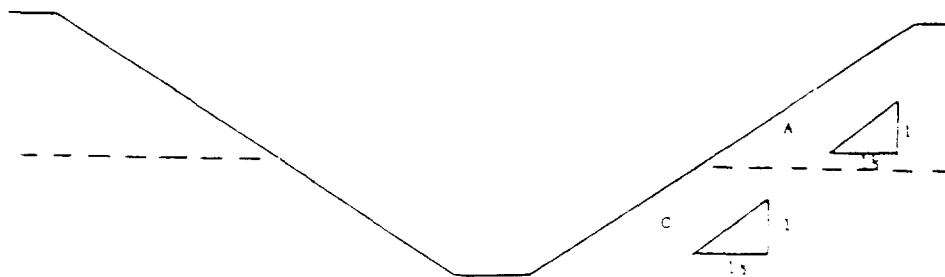
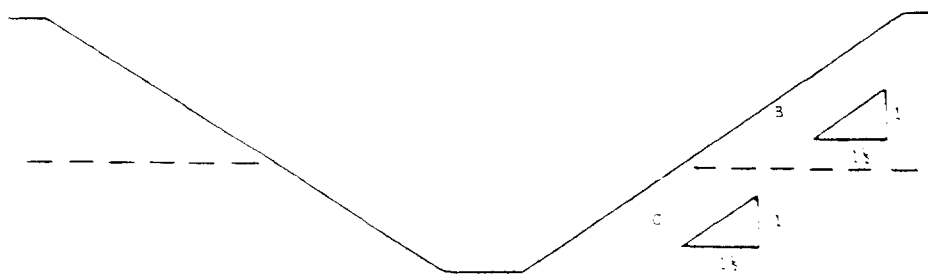
1. All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below.



B OVER A



C OVER A

**C OVER B****A OVER B****A OVER C****B OVER C**

2. All other sloped excavations shall be in accordance with the other options permitted in §1926.652(b).

Appendix C to Subpart P

Timber Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with §1926.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in §1926.652(b) and §1926.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of this part.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables C-1.1, C-1.2 and C-1.3, and Tables C-2.1, C-2.2, and C-2.3 following paragraph (g) of the appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix, and on the tables themselves.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations regarding Tables C-1.1 through C-1.3 and Tables C-2.1 through C-2.3 are presented in paragraph (g) of this Appendix.

(d) *Basis and limitations of the data.*—(1) *Dimensions of timber members.* (i) The sizes of the timber members listed in Tables C-1.1 through C-1.3, are taken from the National Bureau of Standards (NBS) report, "Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations." In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables C-1.1 through C-1.3 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables C-2.1 through C-2.3, or have this choice under §1926.652(c)(3), and are referred to The Corps of Engineers. The Bureau of Reclamation or data from other acceptable sources.

(2) *Limitation of application.* (i) It is not intended that the timber shoring specifications apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in §1926.652(c).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with §1926.652.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a

two-foot soil surcharge. The term "adjacent" as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables.* The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are six tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(f) *Examples to Illustrate the Use of Tables C-1.1 through C-1.3.*

(1) *Example 1.*

A trench dug in Type A soil is 13 feet deep and five feet wide.

From *Table C-1.1*, for acceptable arrangements of timber can be used.

Arrangement #1

Space 4×4 crossbraces at six feet horizontally and four feet vertically.

Wales are not required.

Space 3×8 uprights at six feet horizontally. This arrangement is commonly called "skip shoring."

Arrangement # 2

Space 4×6 crossbraces at eight feet horizontally and four feet vertically.

Space 8×8 wales at four feet vertically.

Space 2×6 uprights at four feet horizontally.

Arrangement # 3

Space 6×6 crossbraces at 10 feet horizontally and four feet vertically.

Space 8×10 wales at four feet vertically.

Space 2×6 uprights at five feet horizontally.

Arrangement # 4

Space 6×6 crossbraces at 12 feet horizontally and four feet vertically.

Space 10×10 wales at four feet vertically.

Space 3×8 uprights at six feet horizontally.

(2) *Example 2.*

A trench dug in Type B soil is 13 feet deep and five feet wide. From *Table C-1.2* three acceptable arrangements of members are listed.

Arrangement # 1

Space 6×6 crossbraces at six feet horizontally and five feet vertically.

Space 8×8 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement # 2

Space 6×8 crossbraces at eight feet horizontally and five feet vertically.

Space 10×10 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement # 3

Space 8×8 crossbraces at 10 feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Space 2×6 uprights at two feet vertically.

(3) *Example 3.*

A trench dug in Type C soil is 13 feet deep and five feet wide.

From *Table C-1.3* two acceptable arrangements of members can be used.

Arrangement # 1

Space 8×8 crossbraces at six feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Position 2×6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

Arrangement # 2

Space 8×10 crossbraces at eight feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Position 2×6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(4) *Example 4.*

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15 feet in depth is determined using *Table C-1.3*. Only one arrangement of members is provided.

Space 8×10 crossbraces at six feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Use 3×6 tight sheeting.

Use of *Tables C-2.1 through C-2.3* would follow the same procedures.

(g) *Notes for all Tables.*

1. Member sizes at spacings other than indicated are to be determined as specified in §1926.652(c), "Design of Protective Systems."

2. When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least three inches thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

3. All spacing indicated is measured center to center.

4. Wales to be installed with greater dimension horizontal.

5. If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds two and one-half feet, uprights shall be firmly embedded or a mudsill shall be used. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench shall not exceed 36 inches. When mudsills are used, the vertical distance shall not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

6. Trench jacks may be used in lieu of or in combination with timber crossbraces.

7. Placement of crossbraces. When the vertical spacing of crossbraces is four feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is five feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

Table C-1.1
Timber Trench Shoring—Minimum Timber Requirements*
Soil Type A $P_s = 25 \times H + 72$ psf (2 ft Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**													
	CROSS BRACES						WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE				
TO 10	UP TO 6	4x4	4x4	4x6	6x6	6x6	4	Not Req'd	—				2x6	
	UP TO 8	4x4	4x4	4x6	6x6	6x6	4	Not Req'd	—					2x8
	UP TO 10	4x6	4x6	4x6	6x6	6x6	4	8x8	4			2x6		
	UP TO 12	4x6	4x6	6x6	6x6	6x6	4	8x8	4				2x6	
10 TO 12	UP TO 6	4x4	4x4	4x6	6x6	6x6	4	Not Req'd	—				3x8	
	UP TO 8	4x6	4x6	6x6	6x6	6x6	4	8x8	4		2x6			
	UP TO 10	6x6	6x6	6x6	6x8	6x8	4	8x10	4			2x6		
	UP TO 12	6x6	6x6	6x6	6x8	6x8	4	10x10	4				3x8	
12 TO 20	UP TO 6	6x6	6x6	6x6	6x8	6x8	4	6x8	4	3x6				
	UP TO 8	6x6	6x6	6x6	6x8	6x8	4	8x8	4	3x6				
	UP TO 10	8x8	8x8	8x8	8x8	8x10	4	8x10	4	3x6				
	UP TO 12	8x8	8x8	8x8	8x8	8x10	4	10x10	4	3x6				
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may be substituted for wood.

Table C-1.2
Timber French Shoring—Minimum Timber Requirements*
Soil Type B $P_a = 45 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15								
										CLOSE	2	3		
5 10 15	UP TO 5	4×6	4×6	6×6	6×6	6×6	5	6×8	5			2×6		
	UP TO 8	5×6	6×6	6×6	6×8	6×8	5	8×10	5			2×6		
	UP TO 11	5×6	6×6	6×6	6×8	6×8	5	10×10	5			2×6		
	See Note 1													
15 20 25	UP TO 5	5×6	6×6	6×6	6×8	6×8	5	8×8	5		2×6			
	UP TO 8	5×8	6×8	6×8	8×8	8×8	5	10×10	5		2×6			
	UP TO 11	5×8	8×8	8×8	8×8	8×10	5	10×12	5		2×6			
	See Note 1													
25 30 35	UP TO 6	5×8	8×8	8×8	8×8	8×8	5	8×10	5	3×6				
	UP TO 8	5×8	8×8	8×8	8×8	8×10	5	10×12	5	3×6				
	UP TO 11	5×10	8×10	8×10	8×10	10×10	5	12×12	5	3×6				
	See Note 1													
OVER 35	SEE NOTE 1													

* Mixed oak is equivalent with a bending strength not less than 800 psi.

** Manufactured members of equivalent strength may be substituted for wood.

Table C-1.3
Timber Trench Shoring—Minimum Timber Requirements*
Soil Type C $P_s = 80 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**												
	CROSS BRACES									UPRIGHTS			
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET) (See Note 2)			
		UP TO 4	UP TO 5	UP TO 9	UP TO 12	UP TO 15				CLOSE			
6	UP TO 4	6×8	6×8	6×8	8×8	8×8	5	8×10	5	2×6			
	UP TO 5	8×8	8×8	8×8	8×8	8×10	5	10×12	5	2×6			
	UP TO 9	8×10	8×10	8×10	8×10	10×10	5	12×12	5	2×6			
	See Note 1												
10	UP TO 4	8×8	8×8	8×8	8×8	8×10	5	10×12	5	2×6			
	UP TO 5	8×10	8×10	8×10	8×10	10×10	5	12×12	5	2×6			
	See Note 1												
	See Note 1												
15	UP TO 4	8×10	8×10	8×10	8×10	10×10	5	12×12	5	2×6			
	See Note 1												
	See Note 1												
	See Note 1												
OVER 15	SEE NOTE 1												

* Sized oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may be substituted for wood.

Table C-2.1
Timber Trench Shoring—Minimum Timber Requirements*
Soil Type A $P_s = 25 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE, S4S, AND SPACING OF MEMBERS**													
	CROSS BRACES							WALES		U PRIGHTS				
	HORIZ SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT SPACING (FEET)	SIZE (IN.)	VERT SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 8	UP TO 10	UP TO 12				CLOSE				
TO 10	UP TO 6	4×4	4×4	4×4	4×4	4×6	4	Not Req'd	Not Req'd				4×6	
	UP TO 8	4×4	4×4	4×4	4×6	4×6	4	Not Req'd	Not Req'd					4×8
	UP TO 10	4×6	4×6	4×6	6×6	6×6	4	8×8	4			4×6		
	UP TO 12	4×6	4×6	4×6	6×6	6×6	4	8×8	4				4×6	
TO 15	UP TO 6	4×4	4×4	4×4	6×6	6×6	4	Not Req'd	Not Req'd				4×10	
	UP TO 8	4×6	4×6	4×6	6×6	6×6	4	6×8	4		4×6			
	UP TO 10	6×6	6×6	6×6	6×6	6×6	4	8×8	4			4×8		
	UP TO 12	6×6	6×6	6×6	6×6	6×6	4	8×10	4		4×6		4×10	
TO 20	UP TO 6	6×6	6×6	6×6	6×6	6×6	4	6×8	4	3×6				
	UP TO 8	6×6	6×6	6×6	6×6	6×6	4	6×8	4	3×6	4×12			
	UP TO 10	6×6	6×6	6×6	6×6	6×8	4	8×10	4	3×6				
	UP TO 12	6×6	6×6	6×6	6×8	6×8	4	8×12	4	3×6	4×12			
OVER 20	SEE NOTE													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

Table C-2.2
Timber Trench Shoring—Minimum Timber Requirements*
Soil Type B $P_s = 45 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS**													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE 2 3 4 6				
TO 10	UP TO 6	4×6	4×6	4×6	6×6	6×6	5	6×8	5			3×12 4×8		4×12
	UP TO 8	4×6	4×6	6×6	6×6	6×6	5	8×8	5			3×8		4×8
	UP TO 10	4×6	4×6	6×6	6×6	6×8	5	8×10	5			4×8		
	See Note 1													
TO 15	UP TO 6	6×6	6×6	6×6	6×8	6×8	5	8×8	5	3×6	4×10			
	UP TO 8	6×8	6×8	6×8	8×8	8×8	5	10×10	5	3×6	4×10			
	UP TO 10	6×8	6×8	8×8	8×8	8×8	5	10×12	5	3×6	4×10			
	See Note 1													
TO 20	UP TO 6	6×8	6×8	6×8	6×8	8×8	5	8×10	5	4×6				
	UP TO 8	6×8	6×8	6×8	8×8	8×8	5	10×12	5	4×6				
	UP TO 10	8×8	8×8	8×8	8×8	8×8	5	12×12	5	4×6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

Table C-2.3

Timber Trench Shoring—Minimum Timber Requirements*

Soil Type C $P_a = 80 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS**													
	CROSS BRACES							WALES		U PRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE				
4 TO 10	UP TO 6	6×6	6×6	6×6	6×6	8×8	8	8×8	8	3×6				
	UP TO 8	6×6	6×6	6×6	8×8	8×8	8	10×10	8	3×6				
	UP TO 10	6×6	6×6	8×8	8×8	8×8	8	10×12	8	3×6				
	See Note 1													
10 TO 15	UP TO 6	6×8	6×8	6×8	8×8	8×8	8	10×10	8	4×6				
	UP TO 8	8×8	8×8	8×8	8×8	8×8	8	12×12	8	4×6				
	See Note 1													
	See Note 1													
15 TO 20	UP TO 6	8×8	8×8	8×8	8×10	8×10	8	10×12	8	4×6				
	See Note 1													
	See Note 1													
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi

** Manufactured members or equivalent strength may be substituted for wood

Appendix D To Subpart P

Aluminum Hydraulic Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used when aluminum hydraulic shoring is provided as a method of protection against cave-ins in trenches that do not exceed 20 feet (6.1m) in depth. This appendix must be used when design of the aluminum hydraulic protective system cannot be performed in accordance with §1926.652(c)(2).

(b) *Soil Classification.* In order to use data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of part 1926.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables D-1.1, D-1.2, D-1.3 and D-1.4. Each table presents the maximum vertical and horizontal spacings that may be used with various aluminum member sizes and various hydraulic cylinder sizes. Each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. Tables D-1.1 and D-1.2 are for vertical shores in Types A and B soil. Tables D-1.3 and D-1.4 are for horizontal waler systems in Types B and C soil.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations (footnotes) regarding Table D-1.1 through D-1.4 are presented in paragraph (g) of this appendix.

(6) Figures, illustrating typical installations of hydraulic shoring, are included just prior to the Tables. The illustrations page is entitled "Aluminum Hydraulic Shoring: Typical Installations."

(d) *Basis and limitations of the data.*

(1) Vertical shore rails and horizontal wales are those that meet the Section Modulus requirements in the D-1 Tables. Aluminum material is 6060 -T6 or material of equivalent strength and properties.

(2) Hydraulic cylinders specifications. (i) 2-inch cylinders shall be a minimum safe working capacity of no less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe working capacity of not less than 30,000 pounds axial compressive load at extensions as recommended by product manufacturer.

(3) Limitation of application.

(i) It is not intended that the aluminum hydraulic specification apply to every situa-

tion that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be otherwise designed as specified in §1926.652(c).

(ii) When any of the following conditions are present, the members specified in the Tables are not considered adequate. In this case, an alternative aluminum hydraulic shoring system or other type of protective system must be designed in accordance with §1926.652.

(A) When vertical loads imposed on cross braces exceed a 100 Pound gravity load distributed on a one foot section of the center of the hydraulic cylinder.

(B) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(C) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables D-1.2, D-1.3 and D-1.4.* The members of the shoring system that are to be selected using this information are the hydraulic cylinders, and either the vertical shores or the horizontal wales. When a waler system is used the vertical timber sheeting to be used is also selected from these tables. The Tables D-1.1 and D-1.2 for vertical shores are used in Type A and B soils that do not require sheeting. Type B soils that may require sheeting, and Type C soils that always require sheeting are found in the horizontal wale Tables D-1.3 and D-1.4. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is made. The selection is based on the depth and width of the trench where the members are to be installed. In these tables the vertical spacing is held constant at four feet on center. The tables show the maximum horizontal spacing of cylinders allowed for each size of wale in the waler system tables, and in the vertical shore tables, the hydraulic cylinder horizontal spacing is the same as the vertical shore spacing.

(f) *Example to Illustrate the Use of the Tables:*

(1) Example 1:

A trench dug in Type A soil is 6 feet deep and 3 feet wide. From Table D-1.1: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(2) Example 2:

A trench is dug in Type B soil that does not require sheeting. 15 feet deep and 5 feet

wide. From Table D-1.2: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(3) A trench is dug in Type B soil that does not require sheeting, but does experience some minor raveling of the trench face. The trench is 16 feet deep and 9 feet wide. From Table D-1.2: Find vertical shores and 2 inch diameter cylinder (with special oversleeves as designated by footnote # 2) spaced 5.5 feet o.c. horizontally and 4 feet o.c. vertically, plywood (per footnote (g)(7) to the D-1 Table) should be used behind the shores. (See Figures 2 & 3 for typical installations.)

(4) Example 4: A trench is dug in previously disturbed Type B soil, with characteristics of a Type C soil, and will require sheeting. The trench is 18 feet deep and 12 feet wide. 8 foot horizontal spacing between cylinders is desired for working space. From Table D-1.3: Find horizontal wale with a section modulus of 14.0 spaced at 4 feet o.c. vertically and 3 inch diameter cylinder spaced at 9 feet maximum o.c. horizontally. 3x12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(5) Example 5: A trench is dug in Type C soil, 9 feet deep and 4 feet wide. Horizontal cylinder spacing in excess of 6 feet is desired for working space. From Table D-1.4: Find horizontal wale with a section modulus of 7.0 and 2 inch diameter cylinders spaced at 6.5 feet o.c. horizontally. Or, find horizontal wale with a 14.0 section modulus and 3 inch diameter cylinder spaced at 10 feet o.c. horizontally. Both wales are spaced 4 feet o.c. vertically. 3x12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(g) *Footnotes, and general notes, for Tables D-1.1, D-1.2, D-1.3, and D-1.4.*

(1) For applications other than those listed in the tables, refer to §1926.652(c)(2) for use of manufacturer's tabulated data. For trench depths in excess of 20 feet, refer to §1926.652(c)(2) and §1926.652(c)(3).

(2) 2 inch diameter cylinders, at this width, shall have structural steel tube (3.5x3.5x0.1875) oversleeves, or structural oversleeves of manufacturer's specification, extending the full, collapsed length.

(3) Hydraulic cylinders capacities. (i) 2 inch cylinders shall be a minimum 2-inch inside diameter with a safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe work capacity of not less than 30,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(4) All spacing indicated is measured center to center.

(5) Vertical shoring rails shall have a minimum section modulus of 0.40 inch.

(6) When vertical shores are used, there must be a minimum of three shores spaced equally, horizontally, in a group.

(7) Plywood shall be 1.125 in. thick softwood or 0.75 inch, thick, 14 ply, arctic white

birch (Finland form). Please note that plywood is not intended as a structural member, but only for prevention of local raveling (sloughing of the trench face) between shores.

(8) See appendix C for timber specifications.

(9) Wales are calculated for simple span conditions.

(10) See appendix D, item (d), for basis and limitations of the data.

Aluminum Hydraulic Shoring Typical Installations

FIGURE NO. 1

VERTICAL ALUMINUM
HYDRAULIC SHORING
(W/OT BRACING)

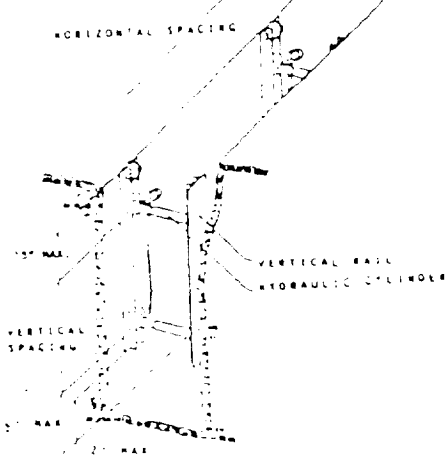


FIGURE NO. 2

VERTICAL ALUMINUM
HYDRAULIC SHORING
(WITH PLYWOOD)

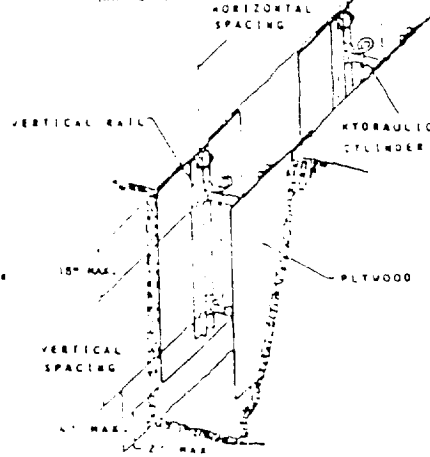


FIGURE NO. 3

VERTICAL ALUMINUM
HYDRAULIC SHORING
(W/OT BRACING)

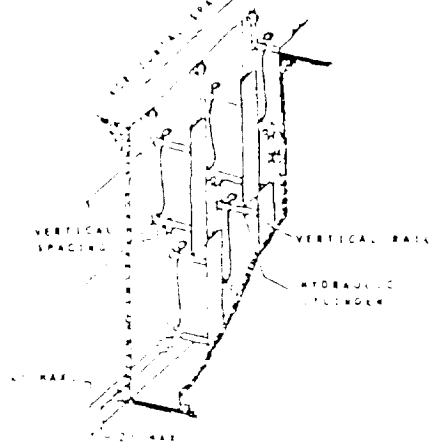


FIGURE NO. 4

ALUMINUM HYDRAULIC SHORING
W/OT SYSTEM
(TYPICAL)

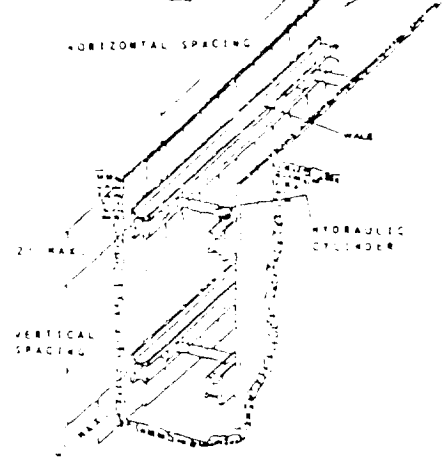


Table D-1.1
Aluminum Hydraulic Shoring
Vertical Shores
For Soil Type A

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	8				
OVER 15 UP TO 20	8				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Note (1): See Appendix D, Item (g)(1)

Note (2): See Appendix D, Item (g)(2)

Table D-1.2
Aluminum Hydraulic Shoring
Vertical Shores
For Soil Type B

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	6.5				
OVER 15 UP TO 20	5.5				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Note (1): See Appendix D, Item (g)(1)

Note (2): See Appendix D, Item (g)(2)

Table D-1.3
Aluminum Hydraulic Shoring
Waler Systems
For Soil Type B

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DEPTH OF TRENCH (FEET)	WALERS		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN ³)	WIDTH OF TRENCH (FEET)						MAX. HORIZ. SPACING (ON CENTER)		
			UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 8 UP TO 12	4	3.5	8.0	2 IN.	8.0	2 IN. NOTE (2)	8.0	3 IN.	—	—	3×12
		7.0	9.0	2 IN.	9.0	2 IN. NOTE (2)	9.0	3 IN.			
		14.0	12.0	4 IN.	2.0	3 IN.	2.0	3 IN.			
OVER 12 UP TO 15	4	3.5	8.0	2 IN.	8.0	2 IN. NOTE (2)	8.0	3 IN.	—	3×12	—
		7.0	9.0	4 IN.	9.0	3 IN.	9.0	3 IN.			
		14.0	12.0	4 IN.	9.0	3 IN.	12.0	3 IN.			
OVER 15 UP TO 20	4	3.5	8.5	2 IN.	8.5	2 IN. NOTE (2)	8.5	3 IN.	3×12	—	—
		7.0	9.0	3 IN.	9.0	3 IN.	9.0	3 IN.			
		14.0	9.0	3 IN.	9.0	3 IN.	9.0	3 IN.			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (c).

Notes (1) See Appendix D, Item (a)(1).

Notes (2) See Appendix D, Item (a)(2).

* Consult product manufacturer and/or qualified engineer for Section Modulus of available walers.

Table D-1.4
Aluminum Hydraulic Shoring
Water Systems
For Soil Type C

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN ³)	WIDTH OF TRENCH (FEET)						MAX. HORIZ. SPACING (ON CENTER)		
			UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 5 UP TO 10	4	3.5	6.0	2 IN	6.0	2 IN NOTE (2)	6.0	3 IN	3×12	—	—
		7.0	6.5	2 IN	6.5	2 IN NOTE (2)	6.5	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 10 UP TO 15	4	3.5	4.0	2 IN	4.0	2 IN NOTE (2)	4.0	3 IN	3×12	—	—
		7.0	5.5	3 IN	5.5	3 IN	5.5	3 IN			
		14.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
OVER 15 UP TO 20	4	3.5	3.5	2 IN	3.5	2 IN NOTE (2)	3.5	3 IN	3×12	—	—
		7.0	5.0	3 IN	5.0	3 IN	5.0	3 IN			
		14.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Notes (1): See Appendix D, item (g)(1)

Notes (2): See Appendix D, item (g)(2)

* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

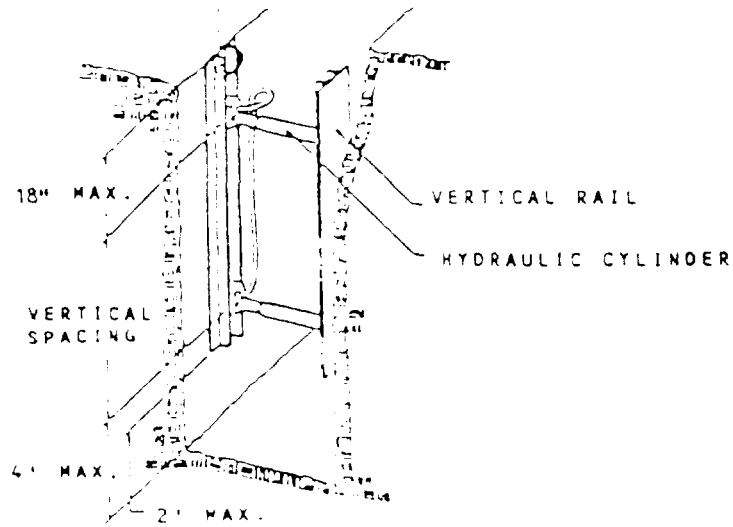


Figure 1. Aluminum Hydraulic Shoring

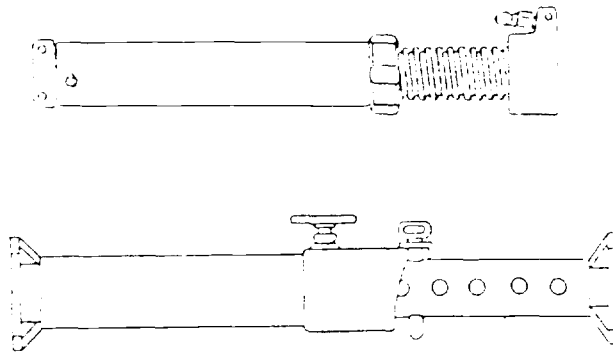


Figure 2. Pneumatic/Hydraulic Shoring

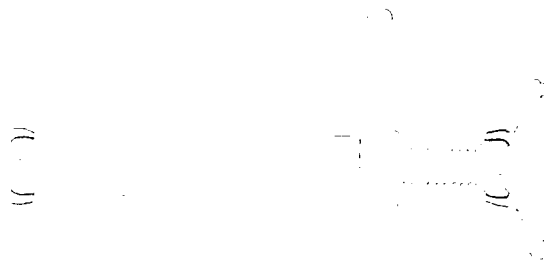


Figure 3. Trench Jacks (Screw Jacks)

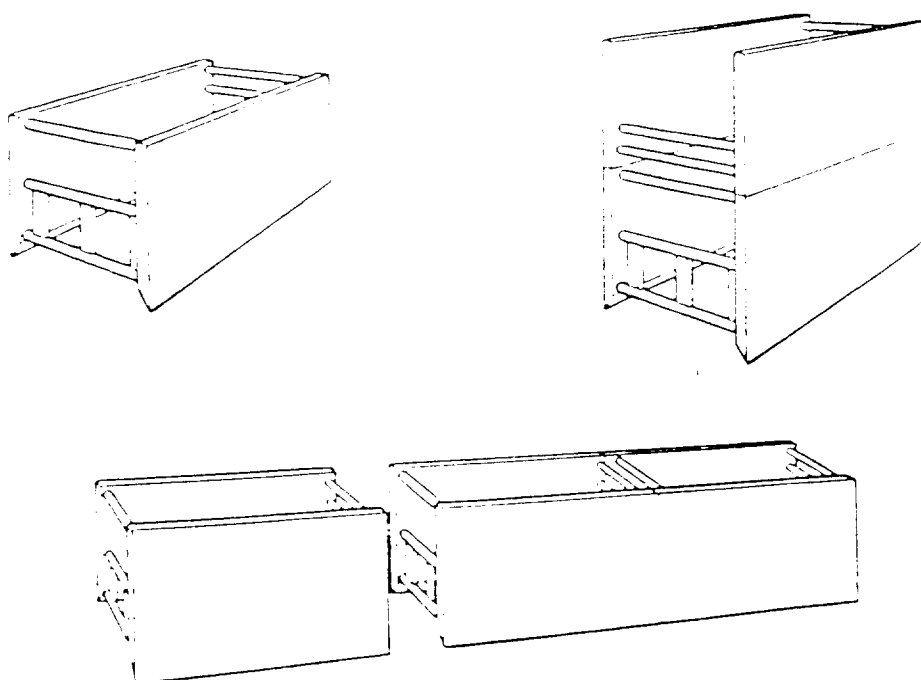


Figure 4. Trench Shields

Appendix F to Subpart P—Selection of Protective Systems

The following figures are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in depth. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordance with §1926.652(b) and (c).

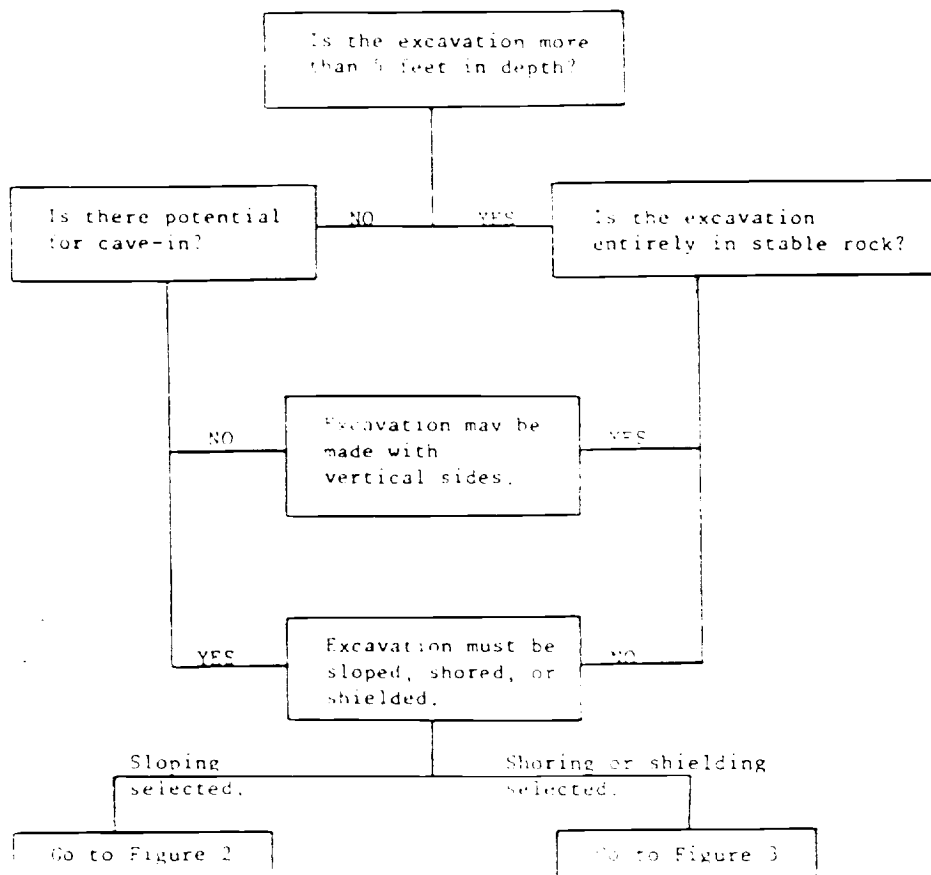


Figure 1—Preliminary Decisions

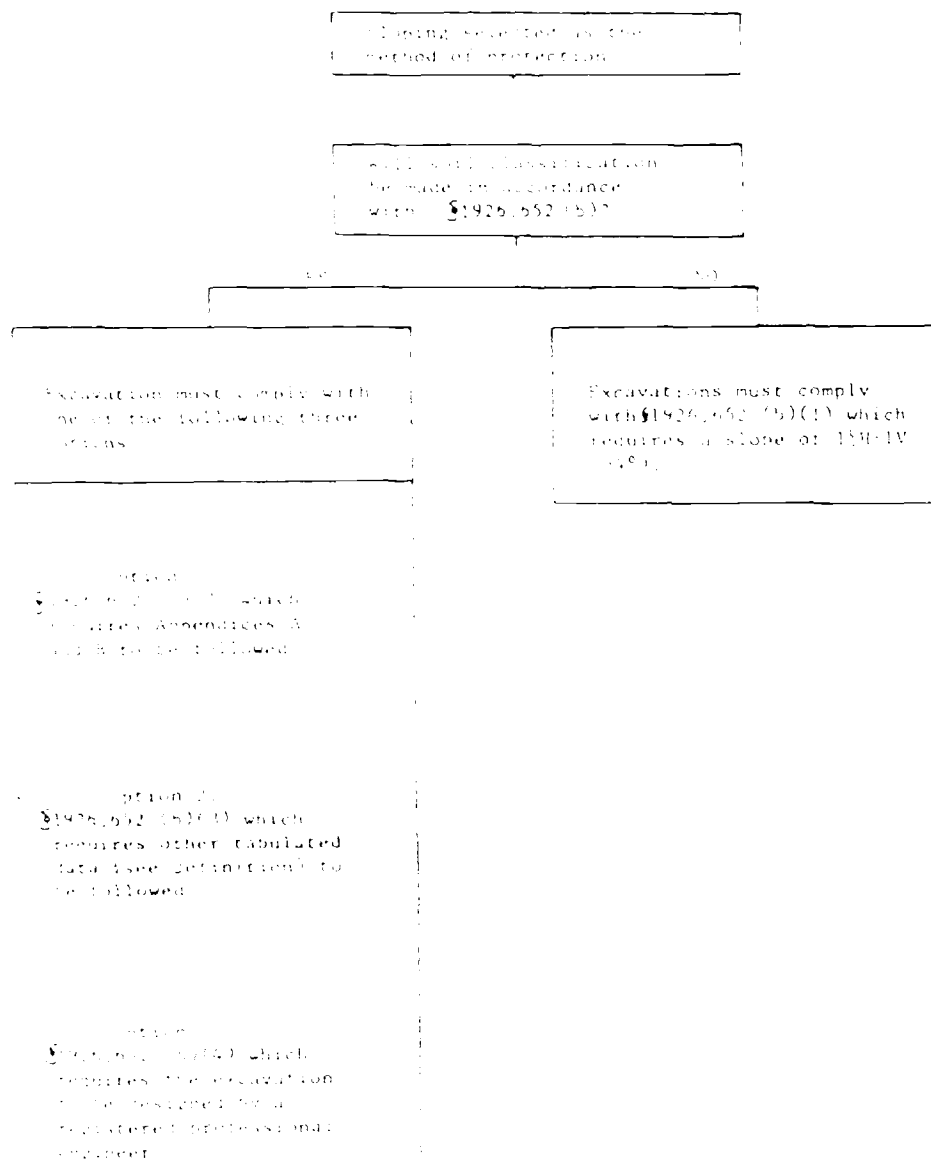


Figure 2—Sloping Options

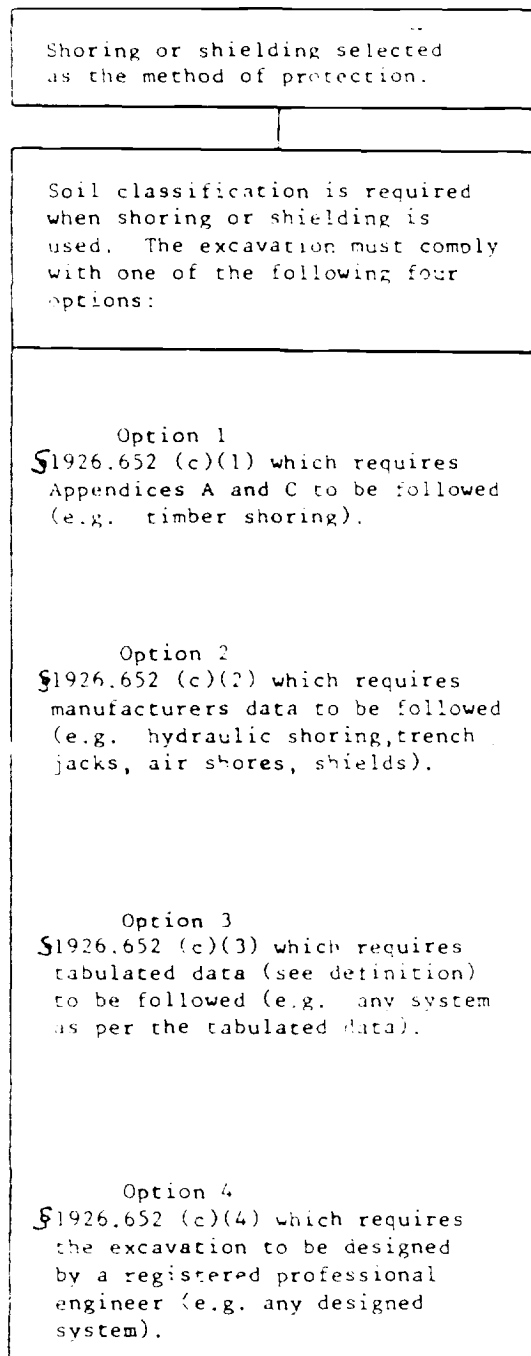


Figure 3—Shoring and Shielding Options

ATTACHMENT L

TRAINING CERTIFICATES

ATTACHMENT M

NIOSH ANALYTICAL METHODS

FORMULA: Table 1

HYDROCARBONS, AROMATIC

M.W.: Table 1

METHOD: 1501

ISSUED: 2/15/84

OSHA, NIOSH, ACGIH: Table 2

PROPERTIES: Table 1

COMPOUNDS:	benzene	cumene	α -methylstyrene	styrene	vinyltoluene
(Synonyms	<u>p-tert</u> -butyltoluene	ethylbenzene	naphthalene	toluene	xylene
in Table 1)					

SAMPLING	MEASUREMENT
SAMPLER: SOLID SORBENT TUBE (coconut shell charcoal, 100 mg/50 mg)	! !TECHNIQUE: GAS CHROMATOGRAPHY, FID ! !ANALYTES: hydrocarbons listed above !
FLOW RATE, VOLUME: Table 3	!DESORPTION: 1 mL CS ₂ ; stand 30 min !
SHIPMENT: no special precautions	!INJECTION VOLUME: 5 μ L !
SAMPLE STABILITY: not determined	!TEMPERATURE-INJECTION: 225 $^{\circ}$ C ! !-DETECTOR: 225 $^{\circ}$ C !
BLANKS: 2 to 10 field blanks per set	!-COLUMN: see step 11 !
BULK SAMPLE: desirable, 1 to 10 mL; ship in separate containers from samples	!CARRIER GAS: N ₂ or He, 25 mL/min ! !COLUMN: glass, 3.0 m x 2 mm, 10% OV-275 on 100/120 mesh Chromosorb W-AW ! !or equivalent !
ACCURACY	!
RANGE STUDIED, BIAS and OVERALL PRECISION (s _r): Table 3	!CALIBRATION: analytes in CS ₂ ! !RANGE AND PRECISION (s _r): Table 4 ! !ESTIMATED LOD: 0.001 to 0.01 mg per sample with capillary column [1] !

APPLICABILITY: This method is for peak, ceiling and TWA determinations of aromatic hydrocarbons. It may be used for simultaneous measurements, though there is the possibility that interactions between analytes may reduce the breakthrough volumes and change desorption efficiencies.

INTERFERENCES: Use of the recommended column will prevent interference by alkanes (\leq C₁₀). Under conditions of high humidity, the breakthrough volumes may be reduced by as much as 50%. Other volatile organic solvents, e.g., alcohols, ketones, ethers and halogenated hydrocarbons, are possible interferences. If interference is suspected, use a less polar column or change column temperature.

OTHER METHODS: This method is based on and supercedes Methods P&CAM 127, benzene, styrene, toluene and xylene [2]; S311, benzene [4]; S22, p-tert-butyltoluene [3]; S23, cumene [3]; S29, ethylbenzene [3]; S26, α -methylstyrene [3]; S292, naphthalene [4]; S30, styrene [3]; S343, toluene [4]; S25, vinyltoluene [3]; S318, xylene [4].

HYDROCARBONS, AROMATIC

METHOD: 1501

REAGENTS:

1. Eluent: Carbon disulfide*, chromatographic quality containing (optional) suitable internal standard.
2. Analytes, reagent grade*
3. Nitrogen or helium, purified
4. Hydrogen, prepurified.
5. Air, filtered.
6. Naphthalene calibration stock solution, 0.40 g/mL in CS₂.

*See Special Precautions.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6 mm OD, 4 mm ID, flame-sealed ends, containing two sections of activated (600 °C) coconut shell charcoal (front = 100 mg, back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available.
2. Personal sampling pumps, 0.01 to 1 L/min (Table 3), with flexible connecting tubing.
3. Gas chromatograph, FID, integrator, and column (page 1501-1).
4. Vials, glass, 1-mL, with PTFE-lined caps.
5. Pipet, 1-mL, and pipet bulb.
6. Syringes, 5-, 10-, 25- and 100- μ L.
7. Volumetric flasks, 10-mL.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and extremely flammable (flash point = -30 °C); benzene is a suspect carcinogen. Prepare samples and standards in a well-ventilated hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min (to 1 L/min for naphthalene or styrene) for a total sample size as shown in Table 3.
4. Cap the samplers with plastic (not rubber) caps and pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL eluent to each vial. Attach crimp cap to each vial immediately.
7. Allow to stand at least 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least five working standards over the appropriate range (ca. 0.01 to 10 mg analyte per sample; see Table 4).
 - a. Add known amounts of analyte (calibration stock solution for naphthalene) to eluent in 10-mL volumetric flasks and dilute to the mark.
 - b. Analyze together with samples and blanks (steps 11, 12 and 13).
 - c. Prepare calibration graph (peak area of analyte vs. mg analyte).

METHOD: 1501

HYDROCARBONS, AROMATIC

9. Determine desorption efficiency (DE) at least once for each batch of charcoal used for sampling in the calibration range (step 8). Prepare three tubes at each of five levels plus three media blanks.
 - a. Remove and discard back sorbent section of a media blank sampler.
 - b. Inject a known amount of analyte (calibration stock solution for naphthalene) directly onto front sorbent section with a microliter syringe.
 - c. Cap the tube. Allow to stand overnight.
 - d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11, 12 and 13).
 - e. Prepare a graph of DE vs. mg analyte recovered.
10. Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1501-1. Select appropriate column temperature:

Substance ^a	Approximate Retention Time (min), at Indicated Column Temperature			
	50 °C	100 °C	150 °C	Programmed ^b
benzene	2.5			2.5
toluene	4.3	1.1		4.2
xylene (<u>para</u>)	7.0	1.4		5.2
ethylbenzene	7.0	1.4		5.5
xylene (<u>meta</u>)	7.2	1.5		5.6
cumene	8.3	1.6		6.0
xylene (<u>ortho</u>)	10	1.9		6.5
styrene	16	2.6		7.6
α -methylstyrene		3.2	1.0	8.1
vinyltoluene (<u>meta</u>)		3.8	1.2	8.5
naphthalene		25	4.3	12

^aData not available for p-tert-butyltoluene and p-vinyltoluene.

^bTemperature program: 50 °C for 3 min, then 15 °C/min to 200 °C.

NOTE: Alternatively, column and temperature may be taken from Table 4.

12. Inject sample aliquot manually using solvent flush technique or with autosampler.
NOTE: If peak area is above the linear range of the working standards, dilute with eluent, reanalyze and apply the appropriate dilution factor in calculations.
13. Measure peak area.

CALCULATIONS:

14. Determine the mass, mg (corrected for DE) of analyte found in the sample front (W_f) and back (W_b) sorbent sections, and in the average media blank front (B_f) and back (B_b) sorbent sections.
NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.

15. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Precisions and biases listed in Table 3 were determined by analyzing generated atmospheres containing one-half, one, and two times the OSHA standard. Generated concentrations were independently verified. Breakthrough capacities were determined in dry air. Storage stability was not assessed. Measurement precisions given in Table 4 were determined by spiking sampling media with amounts corresponding to one-half, one, and two times the OSHA standard for nominal air volumes. Desorption efficiencies for spiked samplers containing only one compound exceeded 75%. Reference [12] provides more specific information.

REFERENCES:


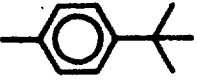
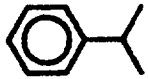
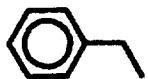
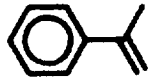

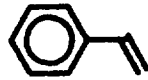
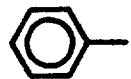
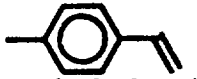

- [1] User check, UBTL, NIOSH Sequence #4121-S (unpublished, December 7, 1983).
- [2] NIOSH Manual of Analytical Methods, 2nd. ed., V. 1, P&CAM 127, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-A (1977).
- [3] Ibid, V. 2, S22, S23, S25, S26, S29, S30, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-B (1977).
- [4] Ibid, V. 3, S292, S311, S318, S343, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).
- [5] R. D. Dreisbach. "Physical Properties of Chemical Compounds"; Advances in Chemistry Series, No. 15; American Chemical Society, Washington (1955).
- [6] Code of Federal Regulations; Title 29 (Labor), Parts 1900 to 1910; U.S. Government Printing Office, Washington (1980); 29 CFR 1910.1000.
- [7] Update Criteria and Recommendations for a Revised Benzene Standard, U.S. Department of Health, Education, and Welfare, (August 1976).
- [8] Criteria for a Recommended Standard....Occupational Exposure to Toluene, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 73-11023 (1973).
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- [10] TLVs - Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment with Intended Changes for 1983-84, ACGIH, Cincinnati, OH (1983).
- [11] Criteria for a Recommended Standard...Occupational Exposure to Styrene, U.S. Department of Health and Human Services, Publ. (NIOSH) 83-119 (1983).
- [12] Documentation of the NIOSH Validation Tests, S22, S23, S25, S26, S29, S30, S292, S311, S318, S343, U.S. Department of Health, Education, and Welfare; Publ. (NIOSH) 77-185 (1977).

METHOD REVISED BY: R. Alan Lunsford, Ph.D., and Julie R. Okenfuss; based on results of NIOSH Contract CDC-99-74-45.

METHOD: 1501

HYDROCARBONS, AROMATIC

Table 1. Synonyms, formula, molecular weight, properties [5].

Name/Synonyms	Structure	Empirical Formula	Molec- ular Weight	Boiling Point (°C)	Vapor Pressure @ 25 °C		Density @ 20 °C (g/mL)	
					(mm Hg)	(kPa)		
benzene CAS #71-43-2		C ₆ H ₆	78.11	80.1	95.2	12.7	0.879	.67
p-tert-butyltoluene CAS #98-51-1 1-tert-butyl-4-methylbenzene		C ₁₁ H ₁₆	148.25	192.8	0.7	0.09	0.861	
cumene CAS #98-82-8 isopropylbenzene		C ₉ H ₁₂	120.20	152.4	4.7	0.62	0.862	
ethylbenzene CAS #100-41-4		C ₈ H ₁₀	106.17	136.2	9.6	1.28	0.867	.07
α-methylstyrene CAS #98-83-9 isopropenylbenzene (1-methylethenyl)-benzene		C ₉ H ₁₀	118.18	165.4	2.5	0.33	0.911	
naphthalene CAS #91-20-3		C ₁₀ H ₈	128.18	80.2 ^a	0.2	0.03	1.025	
styrene CAS #100-42-5 vinylbenzene		C ₈ H ₈	104.15	145.2	6.1	0.81	0.906	
toluene CAS #108-88-3 methylbenzene		C ₇ H ₈	92.14	110.6	28.4	3.79	0.867	.20
vinyltoluene ^b CAS #25013-15-4 methylstyrene methylvinylbenzene	 (p-vinyltoluene)	C ₉ H ₁₀	118.18	167.7 (meta) 171.6 (para) 172.8 (ortho) 169.8	1.6 1.9 1.8 1.8	0.22 0.26 0.24 0.24	0.898 0.911 0.911 0.904	
xylene ^c CAS #1330-20-7 dimethylbenzene	 (p-xylene)	C ₈ H ₁₀	106.17	144.4 (ortho) 139.1 (meta) 138.4 (para)	6.7 8.4 8.8	0.89 1.12 1.18	0.880 0.864 0.861	.06

^aMelting point.^bCommercial mixture of meta and para isomers.^cMixture of isomers.

HYDROCARBONS, AROMATIC

METHOD: 1501

Table 2. Permissible exposure limits, ppm [6-11].

Substance	OSHA			NIOSH		ACGIH		mg/m ³ per ppm
	TWA	C	Peak	TWA	C	TLV	STEL	
benzene	10	25	50 ^a	1		10**	25**	3.19
p-tert-butyltoluene	10					10	20	6.06
cumene	50	(skin)				50	75 (skin)	4.91
ethylbenzene	100					100	125	4.34
α-methylstyrene		100				50	100	4.83
naphthalene	10					10	15	5.24
styrene	100	200	600 ^b	50	100	50	100	4.26
toluene	200	300	500 ^a	100	200*	100	150 (skin)	3.77
vinyltoluene	100					50	100	4.83
xylene	100			100	200*	100	150	4.34

^aMaximum duration 10 min in 8 hr.

**ACGIH: suspect carcinogen [10].

^bMaximum duration 5 min in any 3 hr.

* 10-min sample.

Table 3. Sampling flowrate^a, volume, capacity, range, overall bias and precision [3,4,12].

Substance	Sampling			Breakthrough		Range	Overall	
	Flowrate (L/min)	Volume (L) VOL-NOM VOL-MAX ^b		Volume @ Concentration (L) (mg/m ³)		at VOL-NOM (mg/m ³)	Bias (%)	Precision (s _r)
benzene	≤0.20	2 ^c	30	>45	149	42- 165	0.8	0.059
p-tert-butyltoluene	≤0.20	10	29	44	112	29- 119	-10.4	0.071 ^d
cumene	≤0.20	10	30	>45	480	120- 480	4.6	0.059
ethylbenzene	≤0.20	10	24	35	917	222- 884	-8.1	0.089 ^d
α-methylstyrene	≤0.20	3 ^f	30	>45	940	236- 943	-10.8	0.061 ^d
naphthalene ^e	≤1.0	200	200	>240	81	19- 83	-0.5	0.055
styrene	≤1.0	5 ^g	14	21	1710	426-1710	-10.7	0.058 ^d
toluene	≤0.20	2 ^c	8	12	2294	548-2190	3.8	0.052
vinyltoluene	≤0.20	10	24	36	952	256- 970	-9.5	0.061 ^d
xylene	≤0.20	12	23	35	870	218- 870	-2.1	0.060

^aMinimum recommended flow is 0.01 L/min.^bApproximately two-thirds the breakthrough volume, except for naphthalene.^c10-min sample.^dCorrected value, calculated from data in Reference 12.^eNaphthalene shows poor desorption efficiency at low loading; 100-L minimum volume is recommended.^f15-min sample.^g95-min sample.

METHOD: 1501

HYDROCARBONS, AROMATIC

Table 4. Measurement range, precision and conditions^a [3,4,12].

Substance	Desorption Volume (mL)	Measurement		Carrier Flow (mL/min)	Column Parameters ^b		
		Range (mg)	Precision (s _r)		t (°C)	Length (m)	Packing ^c
benzene	1.0	0.09- 0.35	0.036	50	115	0.9	A
p-tert-butyltoluene	0.5	0.27- 1.09	0.021 ^d	50	115	3.0	B
cumene	0.5	0.86- 3.46	0.010	50	99	3.0	B
ethylbenzene	0.5	2.17- 8.67	0.010	50	85	3.0	B
α-methylstyrene	0.5	0.69- 3.57	0.011	50	115	3.0	B
naphthalene	1.0	4.96-19.7	0.019	30	125	3.0	C
styrene	0.5	2.17- 8.49	0.013 ^d	50	109	3.0	B
toluene	1.0	1.13- 4.51	0.011	50	155	0.9	D
vinyltoluene	0.5	2.41- 9.64	0.008	50	120	3.0	B
xylene	1.0	2.60-10.4	0.010	50	180	0.9	D

^aInjection volume, 5.0 µL; nitrogen carrier gas.^bAll columns stainless steel, 3.2 mm outside diameter.^cA, 50/80 mesh Porapak P; B, 10% FFAP on 80/100 mesh Chromosorb W AW-DMCS;

C, 10% OV-101 on 100/120 mesh Supelcoport; D, 50/80 mesh Porapak Q.

^dCorrected value, calculated from data in [12].

ATTACHMENT N

CURRICULUM VITAE

Curriculum Vitae

GARY R. KRIEGER, M.D., M.P.H., D.A.B.T.

TITLE Manager, Health Systems Group; Manager, Dames & Moore Firm-Wide Health and Safety Program

OFFICE LOCATION Denver, Colorado

EXPERTISE Director of multidisciplinary group supplying services for Environmental Health, Occupational Medicine, Toxicology, Risk Assessment, Public Health Impact Evaluation

EXPERIENCE WITH FIRM Dr. Krieger has been involved in multiple risk assessments, public health evaluations, and siting studies for cogeneration and other industrial/process facilities. He has recently authored and published a large textbook on medical toxicology of hazardous materials. He is certified in Toxicology, Occupational Medicine, and Internal Medicine.

Medical Director/Chief Medical Consultant

- U.S. Department of Commerce/Boulder: National Bureau of Standards, National Weather Service, National Oceanic Atmospheric Agency.
- National Renewable Energy Laboratory
- Kodak Colorado Division

University Affiliations

Assistant Professor. 1987-present
Adjunct, University of Colorado, Boulder
Department of Molecular and Environmental Toxicology, College of Pharmacy

Graduate courses taught: University of Colorado

- Special topics in Occupation Toxicology: Toxicology of Hazardous Materials
- Environmental Risk Assessment

Visiting Faculty, Mayo Clinic, Department of Preventive Medicine

Visiting Faculty, Johns Hopkins University, School of Hygiene & Public Health
1990, 1991, 1992

- Environmental Risk Assessment: Heavy Metal Contamination

DAMES & MOORE

Dr. Gary R. Krieger
(Continued)

**PREVIOUS
EXPERIENCE**

1984-1988 Head, Department of Occupational Medicine/Human Toxicology,
Boulder Medical Center
1984-1986 Director, Urgent Care Clinic, Boulder Medical Center
1982-1983 Medical Director, Exxon Chemical Americas, Baytown
(Houston) Area

CERTIFICATIONS

- American Board of Internal Medicine
- American Board of Preventive Medicine, Section of Occupational
Medicine
- American Board of Toxicology

**LITIGATION
SUPPORT**

Federal Court - knowledge of endangerment issues, human exposure
OSHA - hazard communication, exposure standards
State and District Court - toxic exposures to toxic metals, solvents
Consulting Expert - toxic metals, medical surveillance, indoor air quality,
hazardous materials definitions
Testimonial Expert - Federal, state and regulatory administrative hearings

**ACADEMIC
BACKGROUND**

Master of Public Health, 1982, Johns Hopkins School of Hygiene and Public
Health, Departments of Occupational Medicine and International Health

Residency, 1981, Mayo Clinic, Department of Medicine
Internship, 1979, Mayo Clinic, Department of Medicine
M.D., 1975, University of North Carolina
A.B., 1973, University of North Carolina

**EXPERT
TECHNICAL
APPOINTMENTS**

- ASTM Risk Assessment Task Force
- Contributing Editor, The Occupational & Environmental Medicine
Report

CITIZENSHIP

United States

**COUNTRIES
WORKED IN**

United States

**LANGUAGE
PROFICIENCY**

French: Speaking and Reading: fluent; Writing: good

Curriculum Vitae

JOHN G. DANBY, C.I.H.

TITLE	Associate Manager, Occupational Health and Safety Services Group
EXPERTISE	Industrial Hygiene Occupational Safety and Health Hazardous Waste Field Operations OSHA Compliance Issues
EDUCATION	M.S., Occupational Health, California State University, Northridge, 1984 B.S., Occupational Health, California State University, Northridge, 1983
REGISTRATIONS/ CERTIFICATIONS	Certified Industrial Hygienist (Comprehensive Practice)
EXPERIENCE	<p>Mr. Danby has nine years experience in industrial hygiene practice associated with hazardous waste operations and industrial operations. He currently manages the Occupational Health and Safety Services Group for Dames & Moore's Western Division. The OHSS Group implements the Division's internal health and safety program for over 1500 people in 35 locations.</p> <ul style="list-style-type: none">• Developed and implemented health and safety program which addresses Dames & Moore activities in over 35 divisional offices, coordinates and provides training for field staff, performs field and office audits, develops and implements employee monitoring protocols, tracks employee participation in training programs, develops, reviews and approves site-specific health and safety plans, and reviews health and safety legislation and OSHA-related case law.• Directs the development and ongoing updating of the Dames & Moore Health and Safety Manual. This manual, which encompasses the full spectrum of Dames & Moore technical and support activities, addresses the requirements of Federal OSHA, as well as those specific to OSHA "agreement" states.• Served as lead consultant and health and safety technical liaison for remedial activities at a Superfund site in Baton Rouge, Louisiana, where six Dames & Moore health and safety professionals were responsible for the day-to-day health and safety activities. Site operations included extensive drilling and well installation to characterize the extent of contamination from hexachlorobutadiene and hexachlorobenzene, which resulted from disposal of wastes from petrochemical processing operations. Significant levels of wastes with low PELs necessitated

DAMES & MOORE

John G. Danby, CIH
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supplied-air operations; innovative techniques were required to safely maximize work shifts in the high heat and humidity environment of southern Louisiana.

- Health and safety task manager for the remedial activities at a Superfund site in northern California. Developed health and safety program for activities including soil washing, bioremediation, capping, and groundwater treatment.
- Prepares health and safety plans for remedial activities at former Towne Gas Plant sites on the California State Superfund list. Plans have been prepared for a site in Los Angeles, in which the site was graded and capped, and a site in Venice, where excavation and backfilling will be the remedial activity. Primary contaminants for these sites are polynuclear aromatic hydrocarbons.
- Serves as health and safety task manager for remedial investigation and focused feasibility study at a Superfund site in Torrance, California. Contaminants, including benzene, polynuclear aromatic hydrocarbons, and reactive sulfides, are present in percent quantities, requiring complex worker and community protection planning.
- Directs the development of health and safety plans for investigations, interim remedial measures, and remediation at several inactive wood treatment facilities throughout the U.S. for a wood treating firm. Constituents include creosote, pentachlorophenol, and CCA.
- Prepares health and safety plans for numerous remedial investigations involving borings, trenching, and soil gas surveys at Superfund and non-Superfund sites. Contaminants of concern included PCBs, PAHs, metals, chlorinated and non-chlorinated solvents, and fuel hydrocarbons.
- Directed and/or performed several health and safety audits at industrial facilities in the coatings, electronics and manufacturing sectors.

Associate Industrial Hygienist, California Dept. of Toxic Substances Control (Cal-EPA/DTSC)

- Coordinated Health and Safety Program for regional office of DTSC, including training programs, field audits, personal monitoring, and administrative aspects.
- Principal author of DTSC's Site Safety Plan Guidance Document, which provides regulated community with guidelines for site safety plan preparation. Reviewed, prepared and approved safety plans for projects under Division purview; performed field audits of same.

John G. Danby, CIH
Page 3

- Developed proposal requests for health and safety-related contracts; evaluated and scored proposals.
- Performed compliance inspections of hazardous waste facilities.

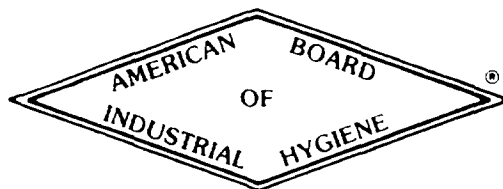
Health and Safety Coordinator, IT Corporation

- Supported regional industrial hygiene operations, including various industrial hygiene consulting projects, asbestos remediation operations, and internal loss control.
- Provided technical support for environmental emergency response operations.
- Served as site safety officer for an investigation of the landfill at Sandia National Laboratory. Site activities included soil boring and trenching to evaluate types and extent of chemical contamination.
- Served as site safety officer at the remediation of a farm chemical distribution facility in Casa Grande, Arizona. Soil excavation was used to remediate pesticide contamination at the facility.
- Served as site safety officer at the remediation of an electronics manufacturing facility in La Mirada, California. Leaking of chlorinated hydrocarbon solvents from USTs required removal of both USTs and surrounding soil.

**PROFESSIONAL
AFFILIATIONS**

American Industrial Hygiene Association
Member, Hazardous Waste Committee
American Society of Safety Engineers
American Academy of Industrial Hygiene
Hazardous Waste Action Coalition
Member, Health and Safety Subcommittee

The
American Board of Industrial Hygiene®
ABIH®



organized to improve the practice of Industrial Hygiene
proclaims that

John G. Danby

having met all requirements through
education, experience, and examination,
is hereby certified in the

COMPREHENSIVE PRACTICE
of
INDUSTRIAL HYGIENE

and has the right to use the designations

CERTIFIED INDUSTRIAL HYGIENIST

CIH

date

July 7, 1989

Chairman ABIH

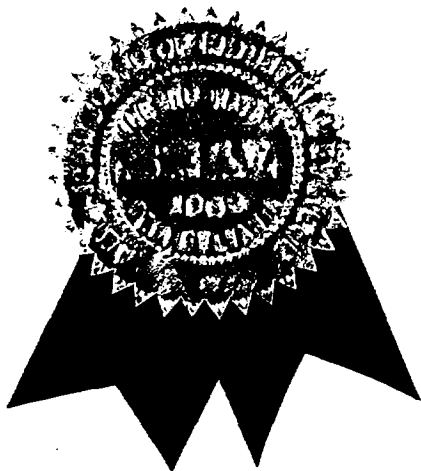
Carl D. Bohl

certificate
number

4212

Secretary ABIH

James R. Thornton



21322

ATTACHMENT O

LABORATORY AIHA CERTIFICATION

TEXAS
DEPARTMENT OF HEALTH

BE IT KNOWN THAT

WATER EARTH SOLUTIONS & TECH INC

is Licensed and authorized to perform as an

ASBESTOS LABORATORY

in the State of Texas within the purview of Texas Civil Statutes, Article 4477-3a, as amended, so long as this License is not suspended or revoked and is renewed according to the rules adopted by the Texas Board of Health.

30-0036

License Number

01/15/93

Issue Date

01/14/94

Expiration Date

This certificate is void
after expiration date
without a current renewal
identification card
displayed here.

Joel H. Smith, P.E.
Chief, Asbestos Programs Branch
Occupational Health Division

David R. Smith, M.D.
Commissioner of Health

VOID IF ALTERED NON-TRANSFERABLE

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ADMINISTRATIVE RECORD

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ADMINISTRATIVE RECORD

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